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ABSTRACT

This report provides specialist information and application-oriented recommendations to implement innovative environmental vocational education and training (VET) measures and practices. Chapter 1 explains study method and structure. Chapter 2 provides an overview of the current state of environmental VET in Austria, Denmark, Finland, Germany, Greece, Luxembourg, Netherlands, Portugal, Spain, and Sweden. Each summary provides basic data on environmental VET; lists legislative decisions on integration of general environmental education into schools; discusses initiatives regarding specific environmental VET; and describes and evaluates the most important training initiatives related to use of solar energy and geothermal energy. Chapter 3 contains a short discourse on the concept and meaning of innovation from the point of view of system theory and for VET before presenting and evaluating these case studies of innovative training initiatives: use of solar and geothermal energy in Greece, Austria, Germany, and Denmark and wind energy in the Netherlands; labor-market integration of specific target groups in Denmark, Sweden, and Spain; social partners initiatives in Austria and Sweden; and local continuing training initiatives in Luxembourg. Chapter 4 analyzes skills requirements for specific target groups and discusses the extent to which good practices can be transferred.

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Chapter 5 estimates the new gainful employment and jobs created through environment-related occupations. (Contains 49 references.) (YLB)

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European Centre for the Development of Vocational Training

PANORAMA

Vocational training and innovative practices in the environmental sector

A comparison of ten EU Member States with specimen cases

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Synthesis report
in the context
of the 'Observing
innovations in vocational
training' project

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Vocational training and innovative practices in the environmental sector

A comparison of ten EU Member States, with specimen cases

Synthesis report in the context of the 'Observing innovations in vocational training' project

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Preface

For some years, environmental skills and competences have been steadily increasing in importance. New EU directives, more restrictive environmental legislation in the Member States and the constantly growing environmental awareness of the general public have given rise to new fields of activity and new markets in the environmental protection and environmental technology sectors, and these will also continue to increase in importance in the future.

In the context of corporate and local authority environmental protection, various measures are being adopted in an effort to reduce energy consumption and to reduce the volumes of pollutants and make them less hazardous. In addition to recycling technologies, technologies for utilisation of renewable energy sources constitute major new growth markets in the environmental sector. In order to improve development of these new areas of environmentally sustainable products and services, but also to comply with more restrictive legal constraints, new qualifications and competences have become necessary in companies in many sectors and in local authority installations. In addition to subject-specific environmental knowledge, this means that there is also above all a need for knowledge in the area of preventive environmental protection and for a deeper understanding of environmental correlations.

Therefore it is of fundamental importance to integrate general environmental knowledge of environmental correlations and specific vocational skills into vocational training in the occupations concerned. But it has also become necessary to impart basic environmental knowledge and the relevant competences as a component of vocational training for most other occupations.

With the project '*Observation of innovations in vocational training*', Cedefop is supporting the European Commission in the analysis and dissemination of innovative practices developed through the Leonardo da Vinci programme. Within the framework of this Cedefop project, in the first project period, in addition to a report on methods of and instruments for assessing trends in skills development, this synthesis report on environmental vocational training in Europe has also been drawn up.

Following a description of the structure and method of the report, Chapter 2 contains a summary of the current position as regards environmental training in ten Member States. Chapter 3 contains a brief discourse on the concept and significance of innovations from the point of view of system theory, followed by a description and evaluation of examples of innovative vocational training initiatives in the countries discussed in the preceding chapter. Chapter 4 analyses environmental skills requirements for specific target groups. This is followed by a discussion of the extent to which the examples of good practice described can help, by means of a transfer to other EU Member States, to improve training quality there. Chapter 5 assesses the extent of the new employment and jobs created as a result of environment-oriented occupations.

In the context of the *'Environmental vocational training'* subject-area of this Cedefop project, national reports have been produced as follows: Konrad Kutt (Federal Institute for Vocational Training), Germany; Peter Schlögl and Oliver Kress (both of the Austrian Institute of Vocational Training Research), Austria, Denmark, the Netherlands and Luxembourg; Harriet Axelsson (Halmstad University),. Sweden; Theo Papatheodossiou (Institute of Technological Education), Greece; Alvaro Martins, Portugal; Virpi Ripatti (National Board of Education), Finland. Peter Schlögl produced a supplementary report on solar technology development in Germany, and Reinhold Gutschik and Peter Schlögl (both of the Austrian Institute of Vocational Training Research) produced a supplementary report on Finland.

These reports, earlier reports drawn up for Cedefop, and further telephone, literature and Internet research have provided the content on which this synthesis report is based.

This report aims to provide decision-makers at European, national and regional levels with specific information and application-oriented recommendations, to help to support them in implementing innovative vocational training measures and practices. However, the text is also designed to provide vocational training researchers working in this area with up-to-date information and advice, to support their scientific work on environmental vocational training in Europe and on ways of improving it.

Roland Loos
Project Coordinator

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Deputy Director

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Chapter 1: Method and structure of the study

Chapter 2 of this report contains a summary of the current position as regards environmental training in ten Member States.

In addition to basic data on environmental vocational education and training in the countries selected for the study, the analysis focuses on two main subject-areas:

- vocational training initiatives and contents, together with market development in the field of solar energy use (active and passive) and the use of geothermal energy;
- environmental education and training initiatives aimed at integrating low(er)-skilled or unemployed young people and other disadvantaged target groups into the labour market.

The two subject-areas constitute *categories that differ in qualitative terms.* The **first area** is a specific segment of the environmental training sector, with several similar or closely associated occupational, job and skills profiles within a particular sector. Skilled workers and engineers are the target groups. The **second area** is an intersectoral category, with a target group consisting of low-skilled workers.

The *first subject-area* was selected for the study because renewable energy sources, but in particular solar energy use, constitute a field in which there is currently a particularly urgent need for new training initiatives and content in the training and continuing training of skilled workers. It is meaningful to include also model vocational training initiatives in the area of use of geothermal energy, because the two areas are closely linked in the context of drafting of an energy plan for buildings in private or industrial use.

The *second subject-area* was addressed in this study because, in addition to environmental vocational training, it also relates to another subject-area specified for the Leonardo da Vinci 1 programme (or at least to the environmental measures segment within this priority area), namely initiatives and measures for integrating low-skilled people into the labour market. As already mentioned in the preface, one of the aims of the Cedefop project 'Observation of innovations in vocational training' is to contribute to the analysis of innovative vocational training practices in selected key areas of the Leonardo da Vinci programme.

The descriptions of measures in individual countries in Chapter 2 are based on a **common basic structure**, but at the same time, depending on the importance of specific measures to the country concerned, one or more of the levels listed below are more intensively incorporated into the analysis.

We begin by listing the most important legislative decisions on integration of **general environmental education** into schools, since a knowledge of global environmental correlations must also be regarded as a basic segment of both general and specifically vocational environmental skills.

Then important initiatives with regard to **specific vocational environmental training** are discussed. First, initiatives in **initial vocational training** and **continuing vocational training** (primarily at skilled-worker level) in all ten Member States selected for this study are

discussed. For some Member States, innovative environmental vocational training measures below skilled-worker level for *integrating low-skilled people into the labour market* are then described. This is followed by a discussion of important environmental training initiatives in *advanced vocational training* (levels of vocational training above skilled-worker level), and in particular at the **level of specialised institutions of higher education and universities**. In states where the social partners play a particularly active part in this area, model **initiatives by the social partners** are included in the analysis.

The most important training initiatives relating to *use of solar energy and geothermal energy* have been described and evaluated for all the states where such initiatives exist. With regard to *education and training initiatives aimed at integrating lower-skilled or unemployed young people into the labour market*, not all the ten Member States have been included in the analysis.

In addition, other particularly important or exemplary vocational environmental training initiatives and measures have also been included in the report.

The main aim of the synthesised national reports is to present current model and innovative environmental VET initiatives in the individual Member States, in order to provide VET researchers and decision-makers with relevant information about current developments. A detailed description of environmental VET in the countries concerned would be outside the scope of these contributions.

In Chapter 3, following a brief discourse on the **concept and significance of innovations** from the point of view of system theory and as regards vocational training, innovative training initiatives in the States covered in the previous chapter are described on the basis of representative specimen cases.

Four subject-areas or levels of environmental VET have been selected for this purpose.

In the context of ***VET practices in specific technological fields***, innovative initiatives are described in the area of *use of solar energy, geothermal energy and wind energy* for skilled workers and other target groups. With regard to solar energy use, the most important initiatives in Greece, Austria, Germany and Denmark at skilled-worker level are analysed. Since the training requirement in the sector is crucially determined by the market trend, in this context the current state of development of the solar technology market in the four countries is also discussed. On the subject of *training initiatives in the field of wind energy use*, an innovative initiative in the Netherlands is described.

Under the heading of ***VET initiatives for the labour-market integration of specific target groups***, initiatives in Denmark, Sweden and Spain are described.

In the field of ***sector-specific initiatives by the social partners***, examples of implementation or improvement of environmental vocational training in Austria and Sweden are presented.

Innovative ***local continuing training initiatives*** were investigated in Luxembourg, and this subject-area has been included in this report primarily because Luxembourg offers no relevant examples of the other subject-areas.

Although these levels are in principle *specific separate areas of environmental VET*, there are also some *links* between them. The first of the two sector-specific initiatives of the social partners described is closely linked to the level of specific technological fields. The VET initiative in Sweden for the labour-market integration of specific target groups is also linked to the technological field of use of renewable energies.

All the specimen cases represent exemplary initiatives in the relevant Member States, and most of them also constitute models for many other Member States. The two local initiatives in Luxembourg described in the context of the fourth subject-area constitute significant innovations for this State, but in comparison with the other specimen cases they are less important in terms of a possible transfer to other States.

Chapter 4 analyses the skills requirements for skilled workers in the field of use of renewable energy sources. It then discusses the extent to which, if the examples of good practice described in Chapter 3 are transferred to other EU Member States, they can help to improve the training level in those States. It goes on to discuss the skills profiles required in order to integrate low-skilled young people into the labour market, by means of environmental vocational training. We then return to the Danish, Swedish and Spanish examples of the integration of the unemployed into the labour market and assess their transferability to other Member States.

Chapter 5 assesses the extent of the new employment and new jobs for skilled workers created by products and services in the environmental sector.

This report is based on data from the results of the first phase of the Cedefop project '*Observing innovations in vocational training*'. In this project, Cedefop is supporting the European Commission in the dissemination of innovations in vocational training, by analysing the potential for innovation in current vocational training approaches and practices in the Member States and in transnational projects and partnerships. This Cedefop publication is intended to provide an overview of the current situation in environmental VET in Member States, to assess innovative practice, and to put forward advice and recommendations for implementation of innovative vocational training initiatives directed at decision-makers at regional, national and Community levels[1]

At **university level**, the courses in 'Environmental sciences' at the Autonomous University of Madrid[2] and the Autonomous University of Barcelona[3] are important examples of environmental VET courses.

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[1] Loos R., 1999. Cedefop INFO, 2/99. Identification and Dissemination of Innovation.

[2] http://www.uam.es/centros/ciencias/licenciaturas/lccaa/lambientales.html

[3] http://www.uab.es/estudis/dosframes.htm

Chapter 2: Current state of development of environmental vocational training in selected EU countries

Austria

In the mid-1970s, Austria began incorporating ***environmental education*** into general scholastic education as an interdisciplinary subject. In 1981, it was incorporated into the curricula of the polytechnic schools (one-year preparatory courses prior to initial vocational training). The environmental education fund established by the Ministry of Education in 1992 is responsible for supporting environmental projects carried out by schools throughout the country.

In 1984, the Ministry of Education set up the 'environmental education working party', which was commissioned to implement various environmental education measures (e.g. holding further education events focusing on the environment, and advising teachers) and to set up and coordinate an information network at national level (European Commission, 1997).

In 1998, this institution (now known as the 'environmental education forum') was mandated by the two competent ministries (Ministries of the Environment and Education) to develop ***vocational environmental*** curricula in **initial training** for all apprentice training/traineeships ('gearing apprentice training/traineeships to the environment' project). Another important project of the forum with a related subject is 'ecologising schools' (Kress O., 1999).

In Austria, initial vocational training at skilled-worker level takes place in the 'dual system', in which, as in Germany, apprentices/trainees receive education in vocational schools as well as in-company training. This assures a uniform training level and ensures that important non-company-specific knowledge and skills are acquired. The training content of each training occupation is regulated by job profiles, which lay down uniform and compulsory national framework standards.

In 1997, following an initiative by the social partners, the Ministry of Economic Affairs began incorporating environmental skills into the job profiles of various training occupations in the metal and electrical sectors. The provision of general environmental knowledge and global environmental correlations is now a compulsory feature of training in all training occupations. For some training occupations, e.g. for four occupations in the metal, electrical and energy sectors, the provision of occupation-specific environmental content during training is also a compulsory feature, both in vocational schools and in enterprises (Loos R., 1996).

In addition to the integration of environmental skills into training occupations, between 1992 and 1997 the environmental training occupation 'recycling and disposal technician' was initiated in the field of initial vocational training, as a training experiment. In 1998, on the basis of this job profile (with additional specialisms in the fields of wastewater and wastes), two specific regular three-year training occupations were created, namely 'disposal and recycling specialist - wastes' and 'disposal and recycling specialist - wastewater'. As yet, however, their significance is relatively limited. In the context of the earlier training experiment, in 1996 only 30 trainees were trained in the whole of Austria (Kress O., 1999).

Since the training occupation 'chemical worker' was created, many young people who previously chose[4] to remain as semi-skilled workers[5] are now training in this occupation. Young people are motivated to do this training mainly because chemical-worker training is less demanding than that of the other two training occupations in the chemicals sector. In addition to information about global environmental correlations, training for this training occupation involves acquiring extensive occupation-specific knowledge in the field of the environment and environmental protection. For many young people, learning this occupation also means markedly changing their attitude to the working environment and the external environment (Loos R., 1996).

In **continuing training** the **social partners'** training institutions (BFI[6] and WIFI[7]) play a central and active part in continuing vocational training for skilled workers and those who have completed secondary vocational training courses. They initiate many innovative continuing training programmes in the field of environmental protection and environmental technology. Two important examples are the First Viennese Solar School at BFI Vienna and the WIFI's Environmental Protection Academy.

Since 1995, the First Viennese Solar School at BFI Vienna has offered a comprehensive programme of continuing training in solar technology and geothermal energy. The target groups addressed by the training are skilled workers and graduates of higher technical training institutions, as well as interested parties in other occupations, such as architects. As an innovative continuing training institution for skilled workers in the field of solar technology and geothermal energy, in conjunction with initiatives in Germany it serves as a model for the whole EU. The teaching programme is primarily based on a good combination of theoretical and application-oriented knowledge in all areas of importance to solar technologies. Interdisciplinary training in this field takes the form of three course modules: *photovoltaics, solar heating and heat pumps*, together with optional modules. Training ends with a project paper and a commission-based final examination (Loos R., 1997).

In addition to environmental and other continuing training activities, BFI Vienna is currently carrying out the Leonardo da Vinci 'Synchro' project. This involves developing and testing training modules for authorised persons for hazardous goods. The modules are intended to assure the first ever uniform quality standard for this training in the EU and thus to fulfil the skills training criteria for these skilled workers in accordance with the EU Directive on authorised persons for hazardous goods (Loos R., 1998).

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[4] Previously, young people who wanted to work in the chemicals sector but saw studying for one of the other two training occupations as too difficult could work only as semi-skilled workers. Training occupations in the chemicals and paper industries in Austria involve a high level of skills. This is essentially a positive feature, as high-quality training puts skilled workers in a stronger position on the labour market. The creation of the somewhat less sophisticated occupation of chemical worker has now also provided a satisfactory training course in this sector for those less interested in learning and weaker trainees.

[5] In Austria, in response to a trade union initiative the discriminatory term 'Hilfsarbeiter' [unskilled or auxiliary worker] has largely been replaced by the term 'Angelernter' [semi-skilled worker].

[6] Berufsförderungsinstitute (institutes of vocational advancement - continuing training institutes of the employee organisations).

[7] Wirtschaftsförderungsinstitute (institutes for the promotion of economic development - continuing training institutes of the employers' organisations).

In addition to BFI Vienna, two small private companies in the Vienna area carry out training in photovoltaics on behalf of the Elektro-Innung (electrical trade guild) Vienna[8]

The WIFI's Environmental Protection Academy offers a three-year course in environmental protection. It is structured as follows: training to become an authorised person for wastes (first year), training to become a waste and recycling technician (second year), and training to be a specialist environmental-protection technician (third year).

An important continuing training centre in the field of ecological construction is the Vorarlberg International School of Solar Construction, which offers special continuing training courses for architects, master builders, construction engineers, planning departments, dealers in building materials, specialist teachers and energy consultants. The environmental and financial aspects of an energy-saving programme in construction are covered in their entirety and in terms of their specific application. The aim is for participants in the courses to be able to identify and assess relevant environmental and financial factors and to apply them in practice (Kress O., 1999).

Within vocational training in secondary schools, some higher technical training institutions (HTLs) teach knowledge and skills in the field of environmental technologies, both in the area of renewable energy sources and relating to waste-treatment technologies and technology for monitoring emissions. The most important example is HTL Pinkafeld, where since 1998 a programme of training in solar technologies has been offered, designed partly on the basis of the First Viennese Solar School's modular structure[9]

In the context of post-secondary vocational training, for some years there have been courses at **specialised institutions of higher education** with training content geared above all to the requirements of industry. Some of them are important centres of vocational training in environmental management and environmental technologies. For example, the Viennese Chamber of Trade and Industry's seven-semester higher-education course in tourism management offers special training in environmental management.

WIFI[10] Innsbruck's eight-semester course in process and environmental engineering is another important example. This course provides sound, practice-oriented and highly interdisciplinary training in the fields of process and environmental engineering (Chamber of Trade and Industry, WIFI course book, 1999).

At **university level**, the University of Soil Reclamation (BOKU), Vienna, in particular offers environmental vocational training. BOKU offers an 'individual diploma course in environmental engineering with consolidation' and a course in 'agricultural planning and landscape conservation' (both ten semesters), and the University of Graz offers an 'individual diploma course in environmental system sciences'. All three of the courses cited are a minimum of ten semesters in length (Kress O., 1999).

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[8] One of these companies is Ing. Helmut Knotz (http://photovoltaik.co.at). Interview with Helmut Knotz, Vienna, 21.1.1999.

[9] Telephone interview with F. Roiz, Head of the First Viennese Solar School, Vienna/Thessaloniki, 16.8.1999.

[10] Wirtschaftsförderungsinstitut (Institute for the promotion of economic development).

Denmark

Denmark is comparatively advanced in terms of incorporating ***environmental education*** into schools. Environmental education was incorporated into biology instruction in 1976. An environmental content was incorporated into social studies classes in 1987, and into chemistry and physics in 1989. The inclusion of an environmental content in primary school curricula was laid down in the 1993 Law on primary schooling (European Commission, 1997).

In 1994, the Ministries of the Environment and Education jointly formulated the objective of incorporating a compulsory environmental content into the curricula of all institutions providing general education and vocational training. In accordance with this objective, all school-based and out-of-school education programmes should contain an environmental element specifically adapted to suit the relevant subject or course (Kress O., 1999).

Today, general environmental studies are widely taught throughout the school system and in apprentice training. Teaching of occupation-specific environmental skills is dependent on initiatives by the relevant schools or enterprises[11]

In the ***environment related*** **initial training** there are virtually no special training facilities for skilled workers in the field of wind energy use, which is important to Denmark. Employees acquire the necessary skills primarily through short in-house training courses and on-the-job training.

In **continuing training** since 1993, three-day training courses in solar heating have been held at Søborg and Herning technical secondary schools, in cooperation with the DTI (Dansk Teknologisk Institut - Danish Institute of Technology). The courses provide participants with theoretical knowledge and practical skills. Since 1998, a craft school has been holding courses in photovoltaics[12]

Denmark leads the world in terms of expenditure on continuing training in relation to GNP. All employees are expressly entitled to receive it. The 24 labour market vocational training centres (Arbejdsmarkedsuddannelses center - AMU) distributed throughout the country play a key part in continuing training. They are managed by the labour market training fund for initial and continuing training, which comes under the aegis of the Ministry of Labour. The AMU centres currently offer 19 environmental course modules. One example of these is the pilot course in 'environmental awareness'. The course content includes environmental management, waste treatment and separation of wastes, and environmentally sustainable technologies. A one-year course in 'transport and treatment of solid and liquid wastes' has been introduced specifically for the unemployed. The main institutions providing continuing training courses in corporate environmental management and eco-auditing are DTI Miljøteknik in Tastrup and TIC Danmark in Esbjerg.

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[11] Telephone interview with B. Clematide, Copenhagen/Thessaloniki, 1.9.1999.

[12] Telephone interview with L. Buhl, DTI, Taastrup/Thessaloniki, 17.8.1999.

In comparison e.g. with Austria, the **social partners** play only a minor part in provision of continuing training measures, but they play a leading part in decision-making processes relating to public-sector continuing training measures. The Danish trade union federation, LO, provides environmental training courses for its members in the trade union's own training college (Kress O., 1999).

The LO has proposed a national strategy for a green industrial policy, in which environmental training and skills development are regarded as key factors. The aim is to develop industrial regulatory tools to impart both external and corporate environmental knowledge, and to promote increased individual responsibility and independent action. Raising the level of employees' skills and competences should at the same time give enterprises competitive advantages (LO, 1998).

Many production schools (produktionsskole) have been set up in Denmark to promote labour-market integration of **unemployed low-skilled** young people. Young people normally attend the production schools for 12 months, but they can leave the school at any time if they have found a job or a training place. Over 5000 young(er) unemployed people currently attend the 107 Danish production schools[13]

Teaching and training do not take the form of a fixed curriculum or modules, but follow outlines. The training plan is also tailored to students' individual needs. Many production schools offer students outlines that are strongly oriented to the environment. Examples of production schools with a strongly environmentally oriented teaching and training content are the Nature School at Roskilde, the Environment and Nature School at Ringsted, and the Pile Mølle production school at Ishøj. At the Pile Mølle production school, for example, young people are offered outline training in *nature and environment, children and environment*, craft outlines in wood and metal processing, and a tourism outline with a strong element of transnational teaching and training activities (Foreningen for Produktionsskoler og Produktionshojskoler, 1999).[14]

An important example of environmental vocational training at **university level** is the two-year course in 'environmental management and eco-auditing' instituted in 1995, in the field of economics. It teaches, in particular, economic skills in the fields of corporate environmental management, environmental planning and eco-auditing.

Finland

In 1994-1995, ***environmental education*** was made an integral part of the framework education and vocational training programmes of compulsory schools and schools at higher levels (European Commission, 1997).

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[13] Telephone interview with A. Hiss, Director of the coordination office for production schools, Vejle/Thessaloniki, 10.9.1999.

[14] Telephone interview with P. Gaarn-Larsen, Director of the EU Centre at Pile Mølle production school, Ishøj/Thessaloniki, 10.9.1999.

To date, ***environmental vocational training*** has played a secondary part in **initial vocational training**. Environmental vocational training takes place primarily at tertiary level in Finland. However, the Ministry of Education has recently implemented initiatives to introduce courses of environmental skills training in the secondary sector also (Ripatti V., 1999).

An important example is the Countryside College of Southwestern Finland, set up at Piikkiö/Paimio in 1998, which offers a one-year course in agricultural trades. In addition to aligning agriculture with the principles of environmental protection and sustainable development, a knowledge of environmental policy and environmental legislation is also imparted. In the context of forestry training, the College at Piikkiö/Paimio offers the option of specialising in environmental protection. This training takes three years[15]

With regard to environmental skills, the content of courses at **specialised institutions of higher education** focuses even more strongly than those of the universities on technical occupations. An important example is the Rovaniemi Polytechnic.[16] Structural engineering training at this institution offers specialisation in both building for a cold climate and low-energy building. In both specialisms, compatibility of economic and environmental considerations constitutes a fundamental training objective. 'Low-energy building' in particular is geared to the principles of sustainable development and focuses on construction and renovation techniques that seem capable of conserving natural and energy resources to the greatest possible extent[17]

The training in engineering for a cold climate has a similar structure. This course is very much geared to practice. Around half the course takes the form of practical training in companies and project work (Gutschik R., 1999).

Programmes of study of farming and forestry at Rovaniemi Polytechnic are also explicitly geared to the environment. The farming course imparts specialist knowledge in northern environmental conditions, taking account of sustainable development principles. It is intended that students should be able to apply these later, e.g. as independent businessmen and businesswomen or in various planning and development occupations of relevance to agriculture. The forestry programme includes an environmental management aspect. In the context of this course, economic, environmental and social aspects of forestry and nature management are covered. The intention is to impart both sound basic environmental knowledge, with special reference to the specific conditions in the north, and an understanding of the social value of the environment and its importance for tourism[18]

Virtually all Finland's 20 **universities** offer courses in an environmentally oriented subject, at least as a subsidiary subject, and nine of them also offer it as a main subject. In addition, specific environmental specialisms can in some cases be followed within individual subject areas (e.g. geology or sociology) (Ripatti V., 1999).

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[15] http://www.saunalahti.fi~maasdial/linlli2.htm

[16] http://www.ramk.fi/english/infopack/1d.html)

[17] http://www.ramk.fi/english/School_of/Technology/ce.html

[18] http://www.ramk.fi/english/School_of/Business_and_Administration/ts.html

The University of Tampere is the only Finnish university to offer a course in 'environment policy'. This comes under the Department for Regional Studies and Environment Policy of the Economics and Management Faculty. In addition to social aspects of environmental problems, the core content of this course consists of regional, national and international environment policy theories. Historical aspects of relevance to environment policy are also covered, as is environmental philosophy. An understanding of environmental management is also imparted in special educational events[19].

A number of transnational educational and vocational training projects are geared to cooperation in the field of environmental protection. In the case of cooperation with Eastern Europe, the Ministry initially concentrated on countries which are near neighbours: Russia, Poland and the Baltic States. A start has now been made on widening these activities further.[20] One example of these initiatives is the University of Kuopio's programme of training in evaluating traffic-related environmental pollution, for Estonian environmental officers[21]

In the field of solar energies, Finland has only a few examples of short training courses at skilled-worker level.

Germany

In 1980 a start was made on gradually introducing ***environmental education*** into compulsory and secondary education (European Commission, 1997).

In **initial training** since 1996, over 120 training regulations have been passed or amended to take account of environmental training requirements. In all the rules passed that have been revised in recent years, environmental protection is specified as a learning goal and skills requirement. One example is the *'occupational safety, accident prevention, environmental protection and rational energy use'* job profile. This encourages trainers to incorporate environmental training into all training activities. In some occupations, there is also training content which specifically links environmental training objectives with specialist content and occupational activities, e.g. *'take into account risks arising from toxins, vapours, gases...'*, *'... list the main regulations on control of air and water pollution...'*, *'list sources of pollution in the workplace and help to reduce them'*, *'dispose of batteries in accordance with the principles of environmental protection'*, *'make appropriate use of recyclable material and recyclable equipment or components'*, or *'dispose of office wastes in an environmentally responsible manner'*. Here, the training objective of awareness of problems and results is linked to the imparting of environmental knowledge and skills.[22]

Only very occasionally do completely new, specifically environmental occupations come into being. It is often a matter of revising an old job profile that is out of date technically, or combining existing training contents in innovative fashion. As yet the only training occupation in the field of technical environmental protection is that of the 'supply and disposal officer', introduced as far back as 1984.

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[19] http://www.uta.fi/laitokset/alue/indexe.htm

[20] http://www.vyh.fi/eng/intcoop/centeast/nereind.htm

[21] http://www.vyh.fi/eng/intcoop/centeast/99joipro.htm

[22] In the dual system, training regulations apply to in-company training and vocational schools are bound by framework curricula. They lay down minimum requirements.

The field of school-based vocational training also includes specific environmental courses ending with a State examination. For example, vocational technical schools offer two- to three-year training courses leading to qualification as an 'environmental technical assistant'.

An important example of a so-called mixed or natural occupation imparting vocational skills in environmental protection is the chimney sweep. In addition to the traditional craft-based activities (sweeping and related activities), the revised version of the training regulation, dating from 1997, provides for imparting of new skills of relevance to the environment, e.g. measurement, monitoring, advice. Another example is the training occupation 'roofer'. In addition to traditional craft-based skills, the new job profile also provides for the installation of energy collectors and energy transformers, e.g. solar collectors and photovoltaic elements, in roofs and walls.

In **continuing training** the example of *solar technology skills training* shows that the training path still primarily follows free (alternative) continuing training options. Attempts to standardise national skills training in the field of solar engineering are still currently failing owing to conflicts of interests and competences. This is all the more surprising in that experts expect annual growth of 25% in photovoltaics and solar heating and forecast a substantial increase in the numbers employed in the field, although high quality specialist knowledge is regarded as essential.

It is also unclear at what stage solar technology should be incorporated into initial vocational training or whether a new job profile for an independent training occupation should also be created. In principle, solar technology training content is of importance for occupations in ancillary trades in the construction sector, such as *'electrician'* and *'sanitary, heating and air conditioning engineer'*.

Experience has shown that solar modules or teaching projects designed to impart basic knowledge of solar technology result in an increased craft-based commitment to solar technology and a need for supplementary skills. This throws up new questions and problems with regard to coordination and cooperation of flexible, modular usability of supplementary solar technology skills. Experience of European projects (particularly several projects implemented in the context of the Leonardo da Vinci programme) suggests that it is conceivable that there could be a development in Germany in which 'solar energy modules' are introduced as part of initial vocational training as well as a supplementary qualification in the context of advanced training.

However, this approach too is called into question when one takes account of the service engineering components of a building. New technical possibilities enable isolated areas of supply and disposal, generation of heat and hot water, use of regenerative energies and controls to come together into complex building system engineering via microprocessors. For these reasons, the Federal Institute for Vocational Training Affairs does not advocate isolated job profiles such as *'solar fitter'* [Solarteur] or *'solar heating planner'*. Instead, advanced training for the occupation of *'building service engineer'* has been proposed, designed to provide access to all relevant building-related crafts. With regard to initial vocational training, this results in elimination of the existing rigid boundaries between training occupations in so far as, in the field of metal-based occupations, for example, more electrical and control engineering skills will be provided for and, conversely, provision will also be made for building system engineering content in electricity-based occupations (Kutt K., 1999).

Irrespective of this debate, a substantial number of well-known vocational training institutions already offer courses of continuing training in solar technology.

The SHK M-V trade association at Crivitz provides training standardised at national level in 'solar heating'.[23]

The workers' training centre of Bremen Chamber of Workers offers a nine-month course of advanced training in 'regenerative energies' for unemployed fitters and heating fitters. The content focuses on *solar water heating, solar heating, rainwater utilisation, heat pumps* and *block heating and generating systems*. Courses of continuing training in 'solar heating' and 'sanitary, heating and air conditioning skilled worker, rainwater utilisation' are planned in 2000.[24]

Kassel institution of higher education has introduced a course in 'energy and environment', a course of continuing training for three semesters for people in employment, focusing on *building and plant engineering possibilities for rational energy use, regenerative energies, energy consultancy, energy economics* and *energy management*. The course involves 220 hours of teaching in the form of lectures and exercises, 135 hours of laboratory experiments or EDP applications of practical relevance, and 135 hours of vocationally oriented project work.[25]

As from 1 February 2000, the (master craftsmen's college of installation, heating and solar engineering) in Freiburg is offering a one-year course of technical college training under the standardised national 'framework syllabus for the craft of central heating and ventilation fitters'. The course involves 40 hours of teaching a week. The syllabus involves specialist theory and practical exercises, covering both the economics-based and legal aspects and vocational and work-oriented education. This initiative is being taken in cooperation with the (Academy of craft occupations / heating and solar technology).[26]

The Euregio solar training centre in Freiburg offers a course leading to qualification as a 'skilled solar engineering worker'. This is designed for master and journeyman craftsmen with at least two years' experience of working in the sanitation/heating/air conditioning, electrical, roofing, glazing or metal sector. It is also open to other interested persons who can demonstrate appropriate knowledge and experience. The aim of the training events is to provide skills training for craftsmen in the use of innovative energy technologies and services. The course is made up of the following modules: *basic energy technology* (20 hours of exercises), *basic heating technology* (30 hours of exercises), *solar heating* (40 hours of exercises), *basic electrical engineering* (30 hours of exercises), *photovoltaics* (40 hours of exercises) and *marketing renewable energies* (40 hours of exercises).

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[23] http://www.installateur.net

[24] regen.energien@abc-bremen.de, http://www.abc-bremen.de

[25] sack@hrz.uni-kassel.de

[26] Holk.Wagner@t-online.de and http://www.rfg.fr.bw.schule.de

Continuing training leading to qualification as a skilled solar engineering worker provides skills in designing and fitting solar heating and photovoltaic systems, starting them up and maintaining them. In Germany, skilled solar engineering workers can also register as master craftsmen in the craft register. The course also teaches the skills required to advise customers efficiently. Participants who complete the course can go on to do a further course leading to qualification as a skilled worker in eco-friendly technologies.[27]

In cooperation with the Richard-Fehrenbach technical school in Freiburg, the Freiburg/Breisgau/Hochschwarzwald sanitation/heating/air conditioning guild offers skills training leading to qualification as a 'skilled solar energy worker', under the training programme of the central sanitation/heating/air conditioning association (ZVSHK). It is designed for employees in this sector and concludes with a standardised state-level examination which is nationally recognised. The training can only be implemented by authorised and certified training establishments. The Richard-Fehrenbach technical school was awarded the German Solar Prize in 1998.[28]

Some organisations offer continuing training leading to qualification as a *solar fitter* [Solarteur] under the training modules developed in the Leonardo da Vinci 'European solar school' project.[29]

In the field of geothermal energy, there are as yet virtually no specific training courses except within the framework of training for solar fitters. For example, vocational schools for well sinkers teach appropriate craft skills, as do heat pump manufacturers in the context of product training (Schlögl P., 1999).

At tertiary level, there are relevant courses at technical universities and specialised institutions of higher education, e.g. the course in geo-engineering sciences and applied geosciences at the Technical University of Berlin.

There are currently some 500 environmental courses at **specialised institutions of higher education** and **universities**. Eighty per cent of these focus on three areas of science, namely *engineering* (over 50%), *natural sciences* and *economics*.

An example of a new, environment-oriented course is geo-ecology (*Geoökologie*), defined by the Geo-ecology Association (Verband für Geoökologie) in Germany as *'an interdisciplinary natural science oriented towards environmental problems. It aims at an understanding of the way the environment functions and operates, in order, in particular, to identify and resolve problems associated with human use'*. At the core of the training is the imparting of basic and expert knowledge of natural sciences and of the application options in practice. The course in geo-ecology was first offered in 1978, at the University of Bayreuth. The subject now exists at five institutions of higher education in Germany.

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[27] Umweltzentrum-Freiburg@t-online.de, http://www.haustechnik.de/umweltzentrum-freiburg

[28] gis.wetzel@t-online.de and http://www.shk.de/freiburg

[29] This initiative is discussed in more detail in Chapter 3.3.

In cooperation with the specialised institution of higher education in Munich, the Institute of Electrical Power Engineering at the Technical University of Berlin has developed an interactive learning system for renewable energies (ILSE). ILSE is designed to impart to interested parties knowledge in the fields of energy, energy problems (greenhouse effect), energy policy and the use of renewable energies such as solar and wind energy. This initiative is currently aimed in particular at students and persons with prior technical knowledge. The Internet was chosen as a medium. It is distinguished by its extensive availability. The online simulations developed also facilitate further use. For example, it is possible to calculate economic efficiency and the CO_2 emissions of various energy systems.[30]

Greece

In 1990 and 1991, Laws were adopted making it possible for teachers to include ***environmental education*** in their lessons. Since then, the Ministry of Education has specifically promoted interdisciplinary (and in some cases transnational) environmental education projects in Greek schools and the establishment of school networks for (inter)active involvement in environmental and environmental-protection issues (European Commission, 1997).

Environmental education in schools is not compulsory. Schools and teachers decide voluntarily whether they will incorporate this subject area into lessons. In order to support the implementation of environmental education, the Ministry of Education has initiated a number of other measures. For example, it was decided to establish institutes of environmental education (KPEs), in which students can participate in environmental projects and teachers are given the opportunity to participate in further education in the form of specific environmental seminars. The KPEs constitute a connecting link between schools, local administrations and scientific training institutions. To date, the greatest progress with regard to implementing environmental education has been made in the first stage of secondary education. A number of curricula include ecology and environmental protection.

In the context of **initial training**, basic information on solar technologies is conveyed in some vocational specialisms. However, environmental vocational training focuses on waste treatment. As yet there is no specific course on renewable energy sources.

Continuing training is primarily provided by State-recognised continuing training centres (KEKs). Environmental training offered includes courses on environmentally sustainable agriculture and landscape conservation, in the context of the national parks. Courses on renewable energy sources are also available, as are courses on environmental protection and waste management - engineering in the fields of industrial environmental management, monitoring of environmental pollution, and recycling. The most important subject areas in these courses are environmental protection and global environmental links, environmental legislation, recycling, and treatment of municipal and industrial wastes. Most of these courses are available only to the unemployed. Such courses are part-financed by the European Social Fund and normally last for 300 hours.

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[30] http://emsolar.ee.tu-berlin.de/~ilse/index2.html

Training measures in the field of technologies for utilisation of renewable energy sources are also offered by Greece's Chamber of Engineering. The Centre for Renewable Energy Sources (KAPE) occasionally offers seminars and short courses providing basic information on alternative energy sources (solar heating, geothermal energy, wind energy).[31]

In some training courses at **specialised institutions of higher education** (TEIs), skills are imparted in the field of utilisation of renewable energy sources. Skills in this field are taught at the Athens TEI, in the context of power engineering, for example, and at the Iraklion TEI under the heading of mechanical engineering.

Most environmental specialisms at **university level** are postgraduate courses. The University of Athens, for example, offers the two-year postgraduate course 'European Environmental Management'. The University of the Aegean offers a degree course whose content includes ecosystems and waste management (Papatheodossiou T., 1999).

The University of Athens and other universities impart knowledge about utilisation of renewable energy sources in the context of vocational training specialisms in the area of energy technologies. The University of Athens also plans to set up, in cooperation with the First Viennese Solar School at the Viennese Institute of Vocational Advancement (BFI Vienna), an interdisciplinary further education facility for the utilisation of solar and geothermal energy, in accordance with the modular concept developed by the Leonardo da Vinci 'European Solar School' project.[32]

Luxembourg

In 1990, ***environmental education*** was added to the curriculum of primary schools. Environmental education has been incorporated into biology lessons in secondary schools. The training of biology teachers includes ecology, and they are given an introduction to environmental education in the course of their teacher training. For all other teachers, only a few in-service practical training measures are available (European Commission, 1997).

The entire field of school-based vocational training is covered by technical secondary schools. Training is divided into three levels: the school-based component of apprenticeship/training (supplementing in-company apprenticeship/training, similarly to the dual system in Germany and Austria), and middle and higher school-leaving qualifications based on vocational training.

Within **initial training** technical secondary schools, as yet only nursing and social work training includes an **environment-oriented subject** (*environmental education and health education*). As from summer 2000, it is planned that the subject 'technology, environment and health' will be introduced into business training, in the form of two hours a week for class 10. In the context of the school-based element of apprenticeship/training, one hour a week will be devoted to *environmental education and health education* in class 10 or 11.

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[31] Telephone interview with A. Dimoudis, Centre for Renewable Energy Sources (KAPE), Athens/Thessaloniki, 16.8.1999.

[32] Telephone interview with F. Roiz, Head of the First Viennese Solar School, Vienna/Thessaloniki, 16.8.1999.

The question of incorporating environmental education into chemistry and physics teaching at technical secondary schools is currently under discussion. However, in the course of this debate, in which the social partners have been involved, misgivings have been expressed as to whether these subjects can really provide subject-oriented and general environmental education in line with the holistic approach aimed at.[33]

As regards **continuing training**, the chambers of the social partners organise continuing training courses at the request of companies. These are then implemented by public or private continuing training providers.

Large companies implement their own continuing training initiatives (e.g. the Luxembourg steel companies). The Chamber of Trade and Industry is the most important body providing environment-oriented continuing training courses.

As regards general education and vocational training and continuing training, Luxembourg often takes advantage of training options available in the neighbouring countries of Germany and France, as it is not efficient for a country with a population of approximately 320 000 itself to offer all relevant specific education and training provision. In addition to university education, this also applies, in particular, to many continuing vocational training measures. It is not uncommon for environment-oriented and other continuing training courses to be implemented in cooperation with providers of German training activities. The ten-month course in 'landscape conservation and environmental protection' and the two-year course in 'waste recycling and water treatment' are two important examples of such initiatives. The courses are attuned to the requirements of companies in Luxembourg and Germany and include a specialised theoretical and practical training content, which is taught in Luxembourg's continuing training centres and German training centres (Kress O., 1999).

Netherlands

In 1988, a long-term programme of ***environmental education*** was drawn up by the Ministries of the Environment and Agriculture, with support from the Ministry of Education. Three years later, a 'multiannual plan for environmental education' for 1992-1995 was published. This lays down general guidelines for environmental education within the education system and for the interdepartmental financing requirement. Six ministries share responsibility for implementing the multiannual plan, but schools are given adequate scope to implement it on an independent basis. In the implementation process, schools are supported by local, regional and national bodies. In the Netherlands, five agencies are responsible for coordinating nature conservation projects for the primary and secondary school sectors (European Commission, 1997).

All areas of ***vocational training*** are covered by inter-sectoral minimum standards for the acquisition of environment-oriented knowledge. These are often linked to knowledge relating to safety at work. In terms of specific implementation, there are major variations in the training process and content, and accordingly in the degree of emphasis on environmental aspects in the training. The Institute for Curriculum Development (SLO) at Enschede is responsible for incorporating environmental aspects into school curricula.[34]

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[33] Until recently, the Biology Programme Committee had sole responsibility for vocational environmental education in schools. Now changes in school curricula in the field of environmental education are also discussed with the social partners. Telephone interview with P. Petry, Ministry of Education, Luxembourg/Thessaloniki, 4.10.1999.

In **initial training, *environment related courses*** in the field of renewable energy sources are usually provided by the relevant companies and research institutes. *Royal Dutch Shell*'s *Shell Solar Division*[35] produces and installs solar plant in the Netherlands and other European countries. Since 1982, the company has provided two-day in-house training courses for managerial staff and skilled workers. In these courses, one day is devoted to theory and one to the acquisition of practical knowledge. In the content of the course, a distinction is made between the two main target groups (technical and marketing staff).[36]

Novem (Nederlandse Onderneming voor Energie en Milieu), the Dutch organisation for energy and the environment, regularly organises courses in photovoltaics.[37] The training organisation Intechnium currently offers a course in using solar heating.[38]

The most important vocational training institutions for vocational environmental training are the *hogeschoolen*, ***specialised institutions of higher education***. Nine *hogeschoolen* offer three- to four-year programmes of environment-oriented training.[39]

One of these specialised institutions of higher education, the Van Hall Institute, offers a course in environmental sciences.[40] This is a four-year course leading to a qualification in environmental engineering. The first year is a preparatory year and the main course then lasts three years. In the latter, the students choose a specialism from six options: *environment policy, environmental technology, environmental health and safety, nature conservation, environmental planning, environmental management.*

The teaching concept is characterised by a strongly problem-oriented approach. The course consists of individual eight-week modules, in which a subject taken from working practice is dealt with in an interdisciplinary way (e.g. modules on soil pollution and wastewater engineering, in which the interdependence of technical, legal, economic and environmental aspects is covered).

Dutch **universities** offer a wide range of programmes and courses in the fields of environmental protection, environmental technology and environmental management.[41]

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[34] The SLO's website address is http://www.slo.nl. Fifty-five publications on the subject of environmental education are currently available from the SLO.

[35] http://www.shell.nl/shell_netherland/organisatie/helmond.html

[36] Workers outside the company cannot normally participate in the training. In the context of a contract for REMU, the regional energy company, persons who were not employees of Shell Solar were also given training.

[37] Novem's website address is http://www.novem.nl and the solar department's website address is http://www.zon-pv.nl/home.htm.

[38] Website: http://www.intechnium.nl.

[39] A complete list, with detailed information on the environmental training programmes offered by these institutions in the 1999-2000 academic year, can be found on the Internet: http://www.euronet.nl/users/hbomil/inhoud.html.

[40] http://www.vhall.nl/umwelt.htm

[41] A list of links to all Dutch universities can be found on: http://www.mit.edu:8001/people/cdemello/nl.html.

The universities are notable for being strongly internationally oriented. Almost all the major Dutch universities offer programmes in English as well as Dutch. For example, the University of Twente[42] offers English-language courses in *'Environmental Management and Consultancy'* and *'Energy Management and Cleaner Production in Small and Medium Scale Industries'*.

One of the most important international study programmes is the *European Postgraduate Course in Environmental Management - EPCEM*[43], which is an initiative by four Dutch university departments in the field of environmental sciences.[44] The EPCEM is a one-year full-time course, and since 1992 over 150 participants have completed it, gaining a *Master's degree in environmental management*.

The Technical University of Delft offers a five-year course for civil engineers, which incorporates training content relating to wind energy.[45] A course in environmental engineering offered by the University of Twente includes an element of training in solar engineering. Since 1985, the University of Eindhoven has held an annual short course in renewable energy sources, which is run by Shell Solar's training manager. A total of 1500 students have taken part in this training initiative to date (Kress O., 1999).

Portugal

In 1989 an interministerial working group drew up proposals for curriculum changes aimed at, among other things, introducing ***environmental education*** into the education system. Environmental education has since been gradually introduced into schools (European Commission, 1997).

In the ***environment related*** **initital training**, there are currently no specific environmental training measures in the context of the national apprentice training system, although at skilled-worker level in particular, there is a shortage of skilled workers who have been adequately trained for environmental activities.

The *Institute for Promotion of the Environment (IPAMB)* is crucially important in the development of specific environmental vocational training measures in **continuing training**. The organisation is under the aegis of the Ministry of the Environment. Between 1995 and 1999, 456 environmental training measures were developed. The framework plan for 1999 covers the following topics: meteorology, noise, water for industrial/domestic use, wastes, regional planning in conservation areas, environmental consultancy, checking environmental compatibility, training of enterprises and special training courses (for journalists, lawyers and auditors, inter alia). Little attention is devoted to vocational training content relating to the use of renewable energy sources. The majority of the courses have a length of under 100 hours.

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[42] http://www.utwente.nl

[43] http://www.vu.nl/english/o_o/instituten/IVM/education/fb_epcem99.html

[44] IVAM, Faculty of Environmental Sciences, University of Amsterdam; Centre of Environmental Science (CML), Leiden University; Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam; Wageningen Center for Environment and Climate Studies (CMKW), Wageningen Agricultural University.

[45] http://www.ct.tudelft.nl/windenergy/

Apart from the active part now played by the Institute for Promotion of the Environment (IPAMB), there are virtually no signs of a specific national vocational training policy in the environmental sector. The vocational training initiatives developed by various institutions follow the general methods laid down for training measures co-financed by the European Social Fund (ESF). They are implemented either directly by employers or in private, public or semi-public educational institutions.

The *Study Centre for Vocational Training for Local Authorities (CEFA)* implements vocational training measures for staff of local administrative authorities. It has developed a wide range of courses, covering subjects ranging from water resources policy and water treatment through waste management, rational energy management and renewable energies to training of environmental consultants. The *training centre of COPRAI, the Portuguese Industrial Association*, promotes training measures in the fields of recycling, wastewater treatment and environmental marketing (Martins A., 1999).

With regard to the use of solar energy, despite excellent conditions the market has not yet developed very far. As yet too little action has been taken to facilitate the creation of a viable market. To date the main use made of solar energy has been for heating, but even this market is still relatively small.

As yet, only a few courses in solar energy use have been held. Courses in solar heating (co-financed by the Alter Programme) are occasionally offered by the Portuguese Society for Solar Energy in cooperation with the National Institute for Industrial Technologies. These consist of theoretical and practical elements. The whole course is 40 hours in length. The primary target groups are fitters with practical experience, teachers at vocational training centres, and skilled workers responsible for continuing training measures within companies.[46]

At **university level**, a number of courses directly linked to environmental vocational training are offered. For example, the New University (*Universidade Nova*)[47] of Lisbon offers a course in 'environmental engineering'. The Modern University (*Universidade Moderna*) of Lisbon offers a course in 'environmental sciences'[48] and the University of Oporto offers a course in 'environmental systems'.[49]

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[46] Course structure, Sociedade Portuguesa de Energia Solar, Instituto Nacional de Engenharia e Tecnologia Industrial, Centro para a Conservação de Energia, 1998.
Módulo teórico
Noções básicas de física, radiação solar, conversão térmica da energia solar, rentabilidade de uma instalação solar, execução manutenção de instalações solares.
Módulo prático
Experiências utilizando 6 instalações experimentais, sendo realizados os seguintes trabalhos:
equilíbrio hidráulico de baterias de colectores
enchimento e purga de sistemas (circuito primário)
funcionamento em termosifão, circulação forçada e 'baixo caudal'
balanços térmicos simplificados
caracterização de colectores
caracterização de bombas circuladoras

[47] http://www.terravista.pt/aguaalto/5695/

[48] http://www.umoderna.pt/ensino/lambiente.html

[49] http://www.fe.up.pt/ecofeup/

Spain

The integration of ***environmental education*** in the school system is not only the task of public institutions: private initiatives (e.g. farm schools, nature hostels, educational fields) and various programmes designed to revive abandoned villages have also made important contributions to the incorporation of environmental education into the public framework curricula.[50]

The Spanish education system is currently being restructured. The 1990 Law on General Rules for the Education System (LOGSE) laid down a minimum teaching content for all areas of the curriculum for the first time, as well as general objectives for environmental education in schools. The *'briefing on respect for and defence of the natural environment'* is regarded as a basic principle underlying all education. The autonomous communities have also undertaken to include environmental issues in their education systems. They accept the State's framework teaching content and put it into concrete form in line with their own regional, geographical and cultural circumstances. Schools are responsible for integrating environmental education into their various teaching activities as an interdisciplinary topic (European Commission, 1997).

In the Spanish province of Murcia, the transnational project *Prodyouth* is currently endeavouring to set up a production school along the lines of the Danish model for **lower skilled** young unemployed people.

Here, the main innovation for Spain is the motivation-oriented alternative learning concept, designed to motivate young people more strongly to learn and to work to acquire skills than is the case in the *Escuelas de Taller* ('workshop schools') set up for excluded young people. In many *Escuelas de Taller*, motivation of young people constitutes a fundamental problem. However, even those *Escuelas de Taller* which operate efficiently do not usually reach the level of skills training and motivation to learn achieved in the Danish production schools.

One obstacle in the way of this project is the securing of long-term financing, but the main obstacle lies in the legal framework conditions, which prohibit schools in Spain from being geared to profit. In order to fulfil the legal criteria, these activities are to be carried out by an association founded for this project. The pilot phase of the project is largely being financed by the Youthstart Programme (Asociacion Columbares, Proyecto transnacional *Prodyouth*;

columbares@distrito.com).[51]

A technical secondary school in Alicante offers an important example of the provision of solar-technology education and training content in the context of **initial training**.[52]

In the field of **continuing training**, the *Centro de Estudios de la Energía Solar* (CENSOLAR) in Seville offers sophisticated training in the field of solar energy use. A key element of CENSOLAR's training courses for solar fitters is a calculation model developed by the training centre, with the aid of which all the calculations required for solar installations can be performed efficiently via computer simulation. CENSOLAR's training activities are centred around correspondence courses. In addition to participants from Spain, to date interested specialists from more than 30 countries have completed correspondence courses with CENSOLAR. The target groups are experienced skilled workers and engineers (CENSOLAR, 1999).

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[50] Interview with Lucas Herrero, teacher at a Spanish workshop school and head of a vocational training project in the field of agriculture, Hervas, Youthstart Conference, 10.12.1999.

[51] Interview with Pilar Lucio, Youthstart Conference, Hervas, 10.12.1999.

[52] Interview with Pilar Aguilar, Youthstart Conference, Hervas, 10.12.1999.

As yet, despite very good conditions, the Spanish solar energy market has not developed very far - in contrast to Greece, where similar climatic conditions obtain. Solar energy is primarily used to provide hot water in private households and hotels. Owing to the relatively minor level of market development, in comparison with the market potential, there are also relatively few training initiatives in this sector.[53]

Zabalnet is an innovative regional-level example of computer-supported correspondence courses, including corporate environmental management inter alia.[54]

At **university level**, the courses in 'environmental sciences' at the Autonomous University of Madrid[55] and the Autonomous University of Barcelona[56] are important examples of environmental vocational training courses.

Sweden

The 1985 Education Act laid down that all teachers must respect environmental and environmental protection values. In 1990, the government decided that ***environmental education*** should be incorporated into teaching in all compulsory schools (European Commission, 1997; Weiters: Act on Education, Stockholm, 1990). In 1991, work began on drawing up new curricula, in which the highest priority was to be given to environmental education in addition to other areas. In 1994, the new programme incorporating environmental education entered into force for elementary schools (European Commission, 1997).

In 1997, a government document set out two important objectives for schools: systematic continuing training for teachers, with a view to raising the level of their environmental competences and their capacity to impart environmentally oriented training content, and the institution of an environmental evaluation system for schools.

There are no training initiatives concerning solar technologies in **initial training**. In the context of **continuing training** for skilled workers, primarily short courses are offered on solar technologies. The Association of Energy Consultants holds short courses lasting from one to three days. The National Institute of Development (SIFU) and Engineer Training (STF) also offer short courses taking account of the use of renewable energy sources. Self-assembly groups assembling solar collectors occasionally organise seminars or short courses providing basic information on the use and possible applications of alternative energy sources and practical skills for assembling solar collectors.

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[53] Naturally there are more training initiatives in the field of solar technology in Spain than there are in most northern European countries.

[54] Telephone interview with Juan Antonio Liedo Rojo, Minano/Thessaloniki, 21.3.2000. See also http://www.zabalnet.com.

[55] http://www.uam.es/centros/ciencias/licenciaturas/lccaa/lambientales.html

[56] http://www.uab.es/estudis/dosframes.htm

The EU-sponsored project *Sustainable Energy and Environment* (SEE) aims to develop and hold a one-year course[57] for unemployed women. In the first part of the project, SEE ADAPT, the specific skills requirements in the local construction sector in the field of energy and the environment were identified. The structure of the second part, SEE NOW, was developed on the basis of these findings. Unemployed women from the construction sector, with university-level training (architects, engineers), are being equipped with sound knowledge in the field of energy and the environment in the context of the construction sector. The aim is to equip course participants to work as environmental and energy consultants in the construction sector once they complete this training (Axelsson H., 1999).[58]

The most important environmental training course at **university level** is the master's course in 'environmental engineering', which takes either two or three years. Three-year courses available focus on the energy market (University of Härnösand) and bio-energy (University of Umeå), and a three-year course in eco-technologies is offered by the University of Östersund. The Universities of Katrineholm and Västerås offer two- to three-year short courses in energy and environmental technology. The Universities of Västerås, Karlstad, Härnösand, Kalmar, Gävle and Umeå offer energy engineering courses of the same length (Axelsson H., 1999).

The first university-level course in solar engineering began in August 1999, the one year master's course at the European Solar Engineering School. This course enables graduates of engineering colleges to acquire comprehensive training in solar technologies.[59] The one-year course covers six subjects/modules: *advanced solar heating*, a further course in *advanced solar heating, advanced photovoltaics, solar architecture/passive use of solar energy, utilisation of solar energy and management of solar energy use,* and *advanced use of solar energy for tropical climates.*

To gain their master's degree, students must complete four of these six subjects and then write a dissertation. The teaching consists of lectures, seminars, discussion groups, practical sessions, computer training for the solar engineering field, and study visits. It is intended that on completion of the course, students should be capable of independently supervising all activities associated with the use of solar energy. They should also be capable of understanding scientific reports on this subject. These teaching units can also be followed individually, as two-month courses (European Solar Engineering School, http://www.eses.org).

Concerning **social partner** initiatives, in 1991, LO, the Swedish Trade Union Federation, developed its own environmental programme, in which environmental protection requirements are closely linked with occupational health and safety. A number of LO's sectoral trade unions offer information courses on this subject in the workplace. TCO, the whitecollar workers' trade union, is implementing a project on 'the environmentally adapted office' in conjunction with national authorities and other organisations. This project is designed to promote environmental awareness in the workplace. TCO has developed a transnational evaluation system, by means of which energy consumption and materials are assessed via EDP. This system is currently the only one of its kind and is in use at international level.

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[57] The precise duration of the course is 50 weeks.

[58] Harriet Axelsson was the coordinator of the SEE NOW project and presented an initial interim report on the course to the *Conference on Environmental Education and Training in Europe* (European Commission) on 4.5.1999.

[59] Telephone interview with S. Gustavsson, SEAS, Stockholm/Thessaloniki, 18.8.1999.

In cooperation with the social partners (SAF and LO), the Swedish Labour Welfare Council has developed materials in which occupational health, corporate environmental protection and global environmental correlations are tackled jointly (including 'Kretslopp - ett måste i framtiden' in 1996 - 'ecocycles - a must in the future').

Chapter 3: Innovations in environmental vocational training, illustrated by selected cases

3.1 The concept of innovation in system theory and vocational training

In the classical system theory of Talcott Parsons, systems of action possess four basic functions: pattern maintenance, integration, goal attainment and adaptation. In developed societies, these four functions are further differentiated into specialised subsystems, in order to increase the ability of the social system to adapt to new system environments (Parsons T., 1975).

From the point of view of system theory and, in particular, according to more recent formulations, innovation can be defined as the product of reactions of the system to altered influences of the system environment. Social systems react to influences from outside the system by continuously adapting structural segments within the system to the new requirements. This is intended to ensure the continued existence of the entire system (Wilke H., 1993).

In this restructuring and reorganisation, new innovative structures and products are configured from existing elements. These are intended to maintain or improve the efficiency of system functions. However, only social systems have the capacity for self-reference and conscious reflection on and evaluation of their own actions, and hence the capacity to introduce innovations. Only by means of the self-reference and structural intelligence of social systems can new, appropriate, independent products and structures be developed out of existing elements (Loos R., 1994).

From the point of view of system theory, the concept of innovation is of importance to vocational training insofar as it brings to the fore the process of adapting structures within the system to altered conditions outside the system. Innovations in vocational training systems are to be understood as 'successful' reactions to changes in systems surrounding the training system or closely associated with it. Trade and industry and the labour market are particularly relevant here.

However, innovative vocational training practices resulting in improvements in vocational training in a particular occupation or sector in one State do not necessarily have the same positive impact within another national vocational training system. Before good practice is transferred, therefore, the framework conditions determining the efficiency of the vocational training innovation in the Member State concerned must be analysed. An assessment must then be made of whether the specific economic, legislative and social structures in the other Member State will facilitate similarly successful implementation.

The European Commission's *Green Paper on Innovation* cites two approaches to assessing innovations:

- the innovation process
- the result and consequences of the innovation.

In the first approach, the investigation focuses on the process leading to an innovation. The form and design of the process are analysed to determine the extent to which they are new and efficient. In the second approach, the result and specific consequences of the innovation are analysed.

To achieve a comprehensive assessment of the efficiency of transferring innovative vocational training practices to other Member States or to candidates for accession to the EU, both dimensions should be included in the analysis (Geers F., 1998).

Vocational training innovations rarely involve completely new ideas, models and practices, but usually primarily involve restructuring of existing, known elements. An innovation does not necessarily need to include completely new elements. This *combining of familiar or new and familiar elements to form a new practice or a new model* represents the essence of innovation in vocational training (Van Rens J., 1998).

It should be borne in mind, however, that this process of recombining cannot be regarded as a mechanical rearrangement of primarily familiar elements and some new elements. It is, rather, a process of ongoing individual reflection on the most efficient way of achieving the goal.

It must also be remembered that in many cases, the elements of an innovation that are already familiar (e.g. ideas, models) have not yet been (more widely) applied in vocational training.

Taking this circumstance into account, it is possible to distinguish three categories of elements by combining which an innovation is developed:

- elements that are already familiar and in use in vocational training,
- elements that are already familiar and are not yet (widely) used in vocational training,
- new elements.

However, an innovation need not necessarily consist of a combination of elements from all three categories.

In this context, the proportion of familiar elements included in the innovative product is not the determining variable with regard to assessing the efficiency of the innovation. An innovation involving 'only' restructuring of familiar elements alone can definitely be highly efficient if this recombining is itself appropriately structured (Geers F., 1998).

In order to be a genuine innovation, the new product must constitute a meaningful new development for vocational training practice. Thus in the case of European projects such as those in the Leonardo da Vinci programme, which should by definition be innovative (the Leonardo da Vinci programme is defined as the laboratory for developing vocational training innovations), the products and approaches developed must be analysed in the light of their ability to be applied and implemented.

In this context, it is useful to classify innovative approaches to vocational training in accordance with a typology (cf. Walter R., 1998).[60]

In the chapters which follow, cases exemplifying innovative vocational training practices will be analysed and the framework conditions for the transfer of these innovations to other Member States will be discussed.

3.2 The potential of the selected cases for innovation

In the descriptions in this chapter, the selected cases will, in particular, be examined to determine to what extent they constitute vocational training innovations for the country concerned. The selection was primarily based on cases that are also innovative for other Member States. The question of the specific potential of the individual cases for innovation transfer will be discussed in more detail in Chapter 4.

In the first subject-area, innovative ***VET practices in specific technological fields***, the potential for innovation in the field of use of solar and geothermal energy lies above all in the efficient and application-oriented design of course content: comprehensive training in the relevant theoretical knowledge and practical skills, or the provision of comprehensive course modules and trans-occupational (particularly in the field of fitters and electricians, but also in associated fields) modular training courses with project work of practical relevance and certification on completion of the course. This applies in particular to the initiatives in Austria and Germany and to those getting under way in Greece.

In this context, Denmark's innovation potential lies in particular in the creation of short courses with a written final test and certification as a solar engineer, together with agreements by the players involved in the solar technology market that only solar heating and PV installations undertaken by a certified solar fitter will receive financial aid from the State. The latter must be regarded as an effective measure in terms of quality assurance for installations.

However, some elements of the actual teaching method used are also innovative (e.g. project papers for the final examination). In Germany and Austria, an Leonardo da Vinci project[61] aims to develop a comprehensive new teaching method with greater involvement of alternative teaching and learning approaches for training in solar technologies and geothermal energy.

In the case of the provision of knowledge in the field of wind energy in the Netherlands, the innovation potential lies both in the strongly internationally oriented course content as regards possible technical applications, and in the efficient combination of conventional and alternative teaching methods.

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[60] The development of a general typology of vocational training innovations and of specific typologies for selected focal areas of vocational training is the objective of the next stage of the Cedefop project 'Observing innovations in vocational training'. This typology is intended to make it easier to analyse the conditions for transferring innovations.

[61] This will be described in more detail in Chapter 3.3.

In the context of the second subject-area, ***VET initiatives for the labour-market integration of specific target groups***, both in the Danish production schools and the relevant initiative in Spain and in the SEE NOW project from Sweden described earlier, the innovation potential lies in the alternative teaching and learning approaches employed. In the Danish production schools, in the case of low-skilled young people they are intended, in particular, to help motivate them to learn and, as regards content, to provide young people who find learning difficult or are less willing to learn with skills of their own choice, relevant to practice.

In the context of the third subject-area, ***sector-specific initiatives by the social partners***, the agreements of the social partners in Austria, their translation into law, and the importing of the content of environmental skills into dual apprenticeship/training in occupations in the electrical, energy and metal sectors, which is compulsory nation-wide, constitute an innovation. Both the process leading to legislative implementation and the content of the vocational training measure are innovative.

The innovative aspect of the RSCs is, in particular, the alternative approach to learning and/or the transmission of knowledge, which acquires additional dimensions thanks to their composition (trade unionists, workers, scientists). The group discussions provide all participants with new knowledge and open up a wider perspective for understanding of environmental issues inside and outside the enterprise.

The innovative aspect of the two ***local continuing training initiatives*** in Luxembourg also lies in alternative learning concepts.

3.3 Use of solar and geothermal energy in Austria, Denmark, Germany and Greece - training initiatives for skilled workers and market development

3.3.1 The situation in Austria

a) Training initiatives and impact with the labour market

In the context of initial vocational training for skilled workers, in the past few years some initiatives have been launched involving the provision of skills relating to solar technology. A number of vocational schools and training enterprises provide basic knowledge and skills in this field. Training in sanitary and heating engineering actually stipulates provision of this basic knowledge, both at vocational school and in the enterprise. However, the definition in the job profile remains a general one and does not stipulate comprehensive occupation-specific skills training measures. Thus it is essentially up to the individual enterprise or vocational school to take the initiative.[62] The Hallein vocational school in the Province of Salzburg offers an extensive training programme at skilled-worker level in the field of solar heating.

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[62] The relevant amendment of the job profiles was the result of an initiative of the social partners.

Since 1995, the First Viennese Solar School at BFI Vienna has offered an important and innovative continuing training programme teaching skills in the field of solar technology and geothermal energy to skilled workers, but also to interested persons in other occupational groups (e.g. graduates of higher technical training institutions and architects). As a continuing training institution for skilled workers in this field, it serves as a model both for Austria and, in conjunction with some initiatives in Germany, for the EU as a whole.

The particularly innovative aspects of the First Viennese Solar School's training programme are the good combination of theoretical knowledge and practical skills and, in terms of content, the comprehensive interdisciplinary training. All the stages of the work (from planning through installation to commissioning and inspection of a system) are imparted to course participants in comprehensive and detailed fashion through a combination of various measurement, assembly and laboratory exercises and theoretical instruction. The actual learning method is primarily traditional, but the measurement, assembly and laboratory exercises (particularly in combination) also involve a project-oriented aspect. In addition, to complete the course, a commission-based final examination must be taken and a project paper produced.

The interdisciplinary training in the field of solar technology takes the form of three course modules: *photovoltaics* (electrical engineering), *solar heating* and *heating pumps* (both from the field of heating engineering), together with optional modules. These include *EDP interpretation of heat load calculation, economic and ecological construction engineering and home technology*, and *automatic refrigeration for air conditioning and refrigeration systems*. Persons without prior relevant specialised training must complete the basic modules *heating engineering* and *electrical engineering* prior to the main modules. The main and optional modules involve 40-50 hours of instruction and can be covered in the form of a one-week full-time course. The whole course, excluding the basic modules and the project paper, involves 200-220 hours of instruction. In the five years the course has been running to date, almost 500 participants have trained as solar fitters ('Solarteur'). However, far more people have completed one or two of the three course modules or one or more of the optional modules, for the purpose of continuing training in their occupation (Loos R., 1997).

As from 2000, BFI Vienna plans to add to the course the one-week module 'electromobiles', as an additional (optional) module. This module aims to provide theoretical and practical knowledge about e-bicycles, e-scooters and e-cars for the disabled. This module will be the first of its kind to be offered by an Austrian continuing training institute, and will thus constitute another innovative element in the Viennese Solar School's continuing training programme.

The planned introduction of this course unit is a response to the market expansion of these products in the past few years. In addition to private individuals, who are showing an increasing interest in e-bicycles and e-scooters, not a few municipalities (including the city of

Vienna) are interested in buying electrically driven municipal vehicles in the wake of their voluntary accession to the Climate Alliance.[63]

In the past few years, two Leonardo da Vinci projects have developed innovative initiatives involving transnational dissemination and application of the Viennese Solar School's modules on the use of solar and geothermal energy, and restructuring of the course content in line with skills requirements at EU level.

In the Leonardo da Vinci *'European Solar School'* project (1996-98)[64], training modules for standardised and comprehensive continuing training of skilled workers in solar technologies throughout the EU were developed on the basis of the First Viennese Solar School's course modules. These are already in use in courses in training institutes in two of the partner countries (Germany and Italy). The Greek project partner, the University of Athens, is currently making plans to introduce this continuing training course (BFI Vienna, 1998).

In the current Leonardo da Vinci project, *'model of an expanded heat pump installation and use as a fixed component of initial vocational training'* (1998-2000)[65], Kreishandwerkerschaft Waldeck-Frankenberg, the First Viennese Solar School at BFI Vienna, and partners from Spain and Greece are developing training modules and learning aids (handbook and CD-ROM) for the provision of skills in the use of geothermal energy via heat pumps. This project is also aimed at developing a new learning concept involving increased use of alternative approaches (group discussions, role-play, etc.), to impart knowledge in the field of solar technology and geothermal energy.

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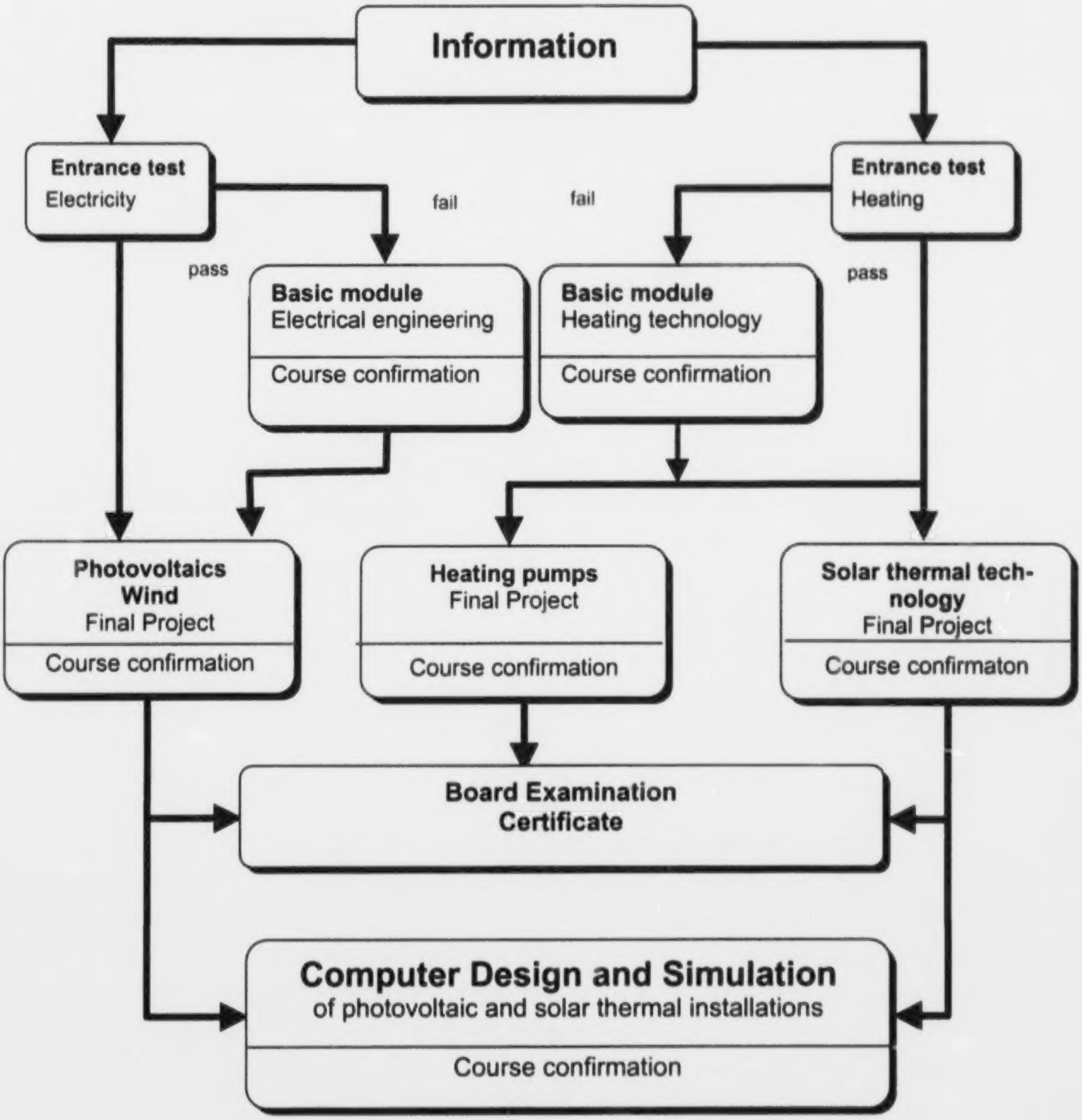
[63] Telephone interview with F. Roiz, Head of the First Viennese Solar School, Vienna/Thessaloniki, 30.6.1999.

[64] BFI Vienna (First Viennese Solar School) was the project coordinator.

[65] Kreishandwerkerschaft (district crafts guild) Waldeck-Frankenberg is the project coordinator.

First Solar School of Vienna

Course curriculum


Information
Entrance test
Electricity
fail
fail
Entrance test
Heating
pass
Basic module
Electrical engineering
Course confirmation
Basic module
Heating technology
Course confirmation
pass
Photovoltaics
Wind
Final Project
Course confirmation
Heating pumps
Final Project
Course confirmation
Solar thermal technology
Final Project
Course confirmaton
Board Examination
Certificate
Computer Design and Simulation
of photovoltaic and solar thermal installations
Course confirmation

Source: BFI Vienna, First Viennese Solar School.

Diagram: CEDEFOP

b) Market development

As regards developing the market for renewable energies, Austria is in second place behind Greece at EU level as regards the use of solar energy for heating[66]. Solar heating is very highly developed in the field of low temperatures in particular, and has long been a genuinely marketable commodity. This sector is experiencing steady growth. The Provinces are also providing aid to promote this market's rapid expansion. Some 1.7 million m^2 of solar collectors have been installed in Austria to date.

In the 1980s and the first half of the 1990s, self-assembly groups played a crucial part in stimulating the solar heating market in Austria. They came into being as the result of an initiative by environmentally aware and committed citizens. In the early years, their activities were largely restricted to the Province of Styria, but later on similar initiatives were also launched in other Provinces. This citizens' initiative in Styria gave rise to the Renewable Energy Working Party, an organisation which, in addition to many other activities, is currently providing basic training for municipal environment officers for the Styrian Provincial Government.

Following a brief period of basic training, members of self-assembly groups themselves assemble solar collectors out of the individual components. They then install them, with the aid of a specialist engineer. The groups' basic training usually consists of a one- to two-day seminar, led by expert members of the Renewable Energy Working Party. In addition to teaching the specific and relatively simple stages involved in assembling the collectors, the training also provides information on possible applications of solar energy and other alternative energy sources in the context of household energy consumption.

Self-assembly groups have declined in importance in the past few years, as thanks to the strongly expanding market, the costs of having solar collectors installed by companies have come down and there is now only a minimal cost advantage.

Photovoltaics, the generation of electricity from solar energy, has not yet really become a marketable commodity. At present, it can only be developed and launched more widely on the market by means of an extensive programme of subsidies. Even if the low operating costs and subsidies from the Provinces are taken into account, the investment costs are still significantly higher than the costs of electric energy from traditional power stations[67] (Austrian Ministry of Economic Affairs, Energy Recovery Agency, 1998).

3.3.2 The situation in Denmark

a) Training initiatives and impact with the labour market

In 1992, the players involved in production and sales of solar collectors introduced innovative measures to stimulate the solar heating market and to provide training for skilled workers. The State energy agency and production and sales companies agreed that only trained fitters with a solar heating certificate may install State-subsidised solar heating. This was designed to ensure that the systems installed functioned correctly. As a result of these compulsory quality criteria, there was a significant increase in activity on the solar heating market.

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[66] Calculated on the basis of the overall area of collectors installed to date.

[67] It should be noted that in Austria, almost 65% of electricity production from conventional power stations is based on another 'traditional' renewable energy source, water power.

Since 1993, as a result of these agreements, three-day training courses in solar heating have been held at the technical secondary schools at Søborg and Herning, in cooperation with the DTI, the Danish Institute of Technology. The course provides participants with theoretical knowledge and practical skills, and end with a written test. To date, 700 fitters have completed this continuing training course and acquired the relevant certificate.[68]

In 1998, the Danish Government decided on a programme of support for the installation of PV systems on buildings in business use. SMEs receive co-financing of up to 40%. These subsidies have made the installation of PV significantly more attractive to companies.

In order to assure the quality of PV systems, in 1998 the players involved introduced an innovative measure to stimulate the PV market similar to that introduced in 1992 for the solar heating market. The PV industry, sales companies and the authorities signed an agreement laying down compulsory quality criteria both for the products and for training for skilled workers. The aim is to avoid the errors made in the 1980s in the field of solar heating, which severely damaged its image for a time.

The agreement lays down that only trained electrical fitters with a PV certificate may install PV systems. PV systems installed by workers not fulfilling these criteria do not receive State subsidies. A three-day course at a technical school must be completed in order to obtain the PV certificate. The training content involves theoretical knowledge and practical skills, and like the solar heating course, it ends with a written test. The course programme covers theory, practical examples and a checklist for planning and installing a PV system. These training courses are currently provided at the craft school at Hadsten[69], in cooperation with the DTI. The DTI's Centre for Solar Energy occasionally carries out quality checks on installations.[70]

b) Market development

In the 1980s, following several years of market expansion, the Danish solar heating market experienced a significant decline in installations. This was because systems were not functioning properly. As a result of the agreements on quality assurance described, the declining trend was successfully reversed.

For a number of years, Denmark's solar heating market has experienced not insignificant growth, but its size is not comparable with that of the market in Austria or Greece. Unlike the solar heating market, the market for photovoltaics is still relatively small, although it too is growing.[71]

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[68] Telephone interview with L. Buhl, DTI, Taastrup/Thessaloniki, 17.8.1999.

[69] Craft schools are part of the technical schools.

[70] Telephone interview with I. Kattnik, DTI, Taastrup/Thessaloniki, 24.8.1999.

[71] Telephone interview with L. Buhl, DTI, Taastrup/Thessaloniki, 17.8.1999.

3.3.3 The situation in Germany

a) Training initiatives and impact with the labour market

In terms of the number of innovative training initiatives and courses in the field of solar technology, Germany is ahead of all the other Member States investigated. However, unlike the Viennese Solar School, these training institutes do not offer combined continuing vocational training in the use of solar heating and geothermal energy for skilled workers.

The Berlin Solar School will be discussed in detail, as an example of an innovative training and continuing training initiative in the field of solar technology. It is the most important advanced and continuing training centre in the field of solar technology in the Berlin/Brandenburg region.

The Berlin Solar School[72] of the DGS (Deutsche Gesellschaft für Sonnenenergie [German solar energy society], Berlin Brandenburg Land association) was set up in 1996 by the DGS Berlin Brandenburg Land association. The sanitary, heating and air conditioning engineering guild (SHK-Innung) is a cooperation partner. The SHK-Innung's central training and continuing training establishment is the headquarters of the Berlin Solar School. The infrastructure available there is also used for the provision of continuing training in solar technology.

In addition to the constructive cooperation with the SHK-Innung, the Berlin Solar School maintains close contact with the Berlin electrical guild and the Berlin roofing association. This means that the trades that are essential to the installation of solar systems are integrated into the Solar School. As a member of the association of solar schools of the federation of energy consumers, the Berlin Solar School is responsible for the 'solar heating systems' training field in the region of Berlin/Brandenburg. Advanced in-company training in photovoltaics and solar heating is carried out in cooperation with Stadtimpuls GmbH.

The cross-trade and interdisciplinary teaching approach of the past two years will be further developed and continued in the medium and long term. In the Berlin Solar School, basic theoretical and practical knowledge of solar, regenerative and rational energy use is imparted in subject-based modules to craftsmen, architects, engineers and planners, specialist management staff and DIY solar plant builders.

In addition to the appropriately equipped training rooms for the theoretical instruction, the guild's workshops are used for practical training. Installation of heating and photovoltaic systems is practised in two roof frames in the solar workshop. Several collector and PV systems are available for this purpose. Training in installation, commissioning and fault detection is carried out on a demonstration solar heating system with model roof outside the school.

Trials and practical exercises in the field of photovoltaics are carried out in the PV workshop, using the 'solar trainer' PV training system developed by a private company in collaboration with the Institute of solar energy supply engineering (ISET). This can be supplemented by testing (characteristic curves, shade, influence of azimuth, gradient and temperature, etc.) based on ten different standard market products (from monocrystalline to amorphous). The operating data from a test system with converter can be measured and read out via computer. Trials are also carried out by the Institute for electrical machinery, photovoltaics test field, of the Technical University Berlin, with which the Solar School maintains good and close contact.

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[72] Source: http://www.solarpolis.de/dgs/

Courses offered by the Solar School include the 'solar engineering specialist' continuing training course, which is aimed at unemployed master craftsmen, technicians and engineers in the fields of sanitary, heating and air conditioning engineering, electrical engineering, process engineering, construction and other technical occupations. A requirement is that participants should be interested in regenerative energies (in particular, solar technology) and rational energy use. The course is subsidised by the employment office.

Course content:

- basic heating engineering
- basic electrical engineering
- solar heating
- photovoltaics
- basic computing
- automatic control engineering
- basic business studies
- regenerative energies
- three months of in-company practical training

At the end of the 'solar engineering specialist' course, an examination can be taken in order to acquire the DGS 'solar engineering specialist' certificate. The examination comprises a written element (solar heating, PV) and a practical element (including pipe laying, months of a PV system).

Since 1996, over 400 specialists or enterprises have trained in solar engineering topics at the DGS's Berlin Solar School.

Another important element of the training is the further monitoring of participants after they complete the courses. Here, the excellent contacts with installation companies, the association of enterprises in the solar industry and the guilds play a crucial part.

The good cooperation and exchange of experience with the Technical University, the Free University, the Hahn-Meitner Institute and the specialised institutions of higher education in Berlin ensure that the latest scientific discoveries also flow into the continuing training measures. The same is true of product innovations and new developments, which are also taken into account in the relevant curricula.

b) Market development

The German solar heating market is characterised by constant (although fluctuating) growth rates. According to estimates by the association, some 380 000 m² of new collectors were installed in 1997 (1996: 269 000 m²). The Federal and *Land* incentive programmes in particular have made growth possible, with increases of between 15 and 30%.

According to a recent survey of the *Länder* and the Federation, over 100 000 solar heating systems with approximately 740 000 m² of collectors were subsidised between 1990 and 1997.

The photovoltaics market in Germany has not yet gathered momentum. However, following the planned construction of new solar cell plants, national production capacities in the field of photovoltaics can be expected to increase substantially (Schlögl P., 1999).

3.3.4 The situation in Greece

a) Training initiatives and impact with the labour market

In Greece, training initiatives for skilled workers are lagging behind the skills requirements in this growth sector. In the context of initial vocational training, as yet skills linked to this sector are imparted to only a limited extent (Fissamber V., 1996).

As yet there is no special training programme at skilled-worker level for solar technologies and other technologies involving the use of renewable energy sources. If such a programme were to be set up in the context of initial vocational training, this would represent an important innovation for this field of vocational training.[73]

The University of Athens, in cooperation with the First Viennese Solar School, is planning an important innovative measure to develop training in solar technologies in Greece. It is planning to set up a solar school, to provide interdisciplinary training in solar technologies (solar heating and photovoltaics) and technologies for the use of geothermal energy, in accordance with the three training modules developed in the Leonardo da Vinci 'European Solar School' project.[74] Theoretical knowledge and practical skills are to be imparted in a well-coordinated and comprehensive fashion for all three areas. The main target group is skilled workers (BFI Vienna, 1998).

Some Regional Energy Centres[75] hold courses for the unemployed on technologies for utilisation of renewable energy sources, which contain innovative elements.

Here, aspects that are innovative for Greece are the increased incorporation of provision of practical skills, the interdisciplinary training content (solar heating, photovoltaics, passive solar energy use and, to a certain extent, geothermal energy), and the project paper for the final examination. An important example of an institution holding such courses is the Regional Energy Centre of Macedonia/Thessaloniki. In the past year, it has held six courses on energy-saving measures for buildings and on the use of renewable energy sources. Two courses are currently in progress, and others are planned for the autumn. Fifteen to twenty participants take part in each course. Courses are offered for skilled workers and for those with higher technical skills (TEI or university graduates). The content is adapted to suit the relevant target group in each case, but the courses share the common basic structure outlined below.

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[73] Telephone interview with A. Dimoudis, Centre for Renewable Energy Sources (KAPE), Athens/Thessaloniki, 16.8.1999.

[74] Telephone interview with F. Roiz, Head of the First Viennese Solar School, Vienna/Thessaloniki, 16.8.1999.

[75] The Regional Energy Centres are coordinated by the regions.

The courses involve 300 hours of classes. Some 200 of these are devoted to theoretical instruction and 100 to practical instruction. An energy audit of selected construction projects is performed in the context of the practical instruction. This involves performing cost/benefit calculations on site for energy-saving measures and installations. In the skilled-worker courses, solar collectors are installed. While much of the training content covers solar technologies, only a single day of the course is devoted to an introduction to technologies for using geothermal energy. The course ends with a project paper (performing an energy audit of a building). The main difference between these courses and the usual KEK[76] courses lies in their more extensive practical component and the project paper.

b) Market development

As regards developing the market, Greece leads the EU by a long way in terms of the use of solar energy for heating.[77] Solar systems began to be used more widely to heat water 25 years ago. The large increase in electricity prices in the 1970s and the oil crisis played a crucial part in the sector's rapid growth.[78]

At present 22% of all Greek households have solar heating installations.[79] On some Aegean islands the proportion is as high as around 50%. The area of collectors installed to date is 2.4 million m². No comparable market has evolved to date in other EU countries with a similarly favourable climate - in particular, Spain and Portugal.

On average, about 85% of the annual hot-water requirement can be covered in households with solar systems. Large numbers of new systems are installed each year, although the figures have fallen back slightly in the past few years. It can be assumed that large numbers of new systems will continue to be installed each year in future (Zervos A., 1998).

There is still considerable sales potential in the field of private households. In the context of buildings used for business purposes, the hotel sector in particular constitutes an important customer segment. In new buildings in particular, solar heating proves more cost-effective than conventional fossil-fuel energy sources (in a long-term cost/benefit calculation taking account of the average amortisation term)[80]. Tax concessions linked to the purchase of a solar system are a statutory regulation designed to promote expansion of the solar heating market. A planned law stipulating that pipes should be provided for in the planning and construction of new buildings, to facilitate later installation of solar systems, was not ratified.

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[76] The KEKs are the State-recognised continuing training institutes. Continuing training courses for the unemployed run by the KEKs are co-financed from the public purse.

[77] Both in terms of the overall area of solar collectors installed to date and in terms of the percentage of households with solar heating installations.

[78] The first simple technical system for using solar energy for heating was developed by Archimedes over 2000 years ago.

[79] Telephone interview with A. Dimoudis, Centre for Renewable Energy Sources (KAPE), Athens/Thessaloniki, 16.8.1999.

[80] The amortisation term is dependent on a household's hot-water consumption. In the Mediterranean region,
it averages five to six years. It is shorter than this for households with higher consumption (e.g. a family with two or more children), and also for hotel and holiday facilities operating only (or principally) in the summer.

Although the annual rates of new installations are now lower than the peak levels of ten years ago, the market for installations in existing buildings has not yet reached saturation point. In this context, it is interesting to compare Greece with Cyprus where, with similar climatic conditions, over 60% of all households (92% of all houses)[81] have solar heating installations (Chamber of Trade and Industry, Nicosia, 1999, Statistics on the solar heating market)[82]. Installation of solar systems in new buildings will also be a dynamic market in the long term. In future, installations combining solar water heating and part-solar space heating will play an increasingly important part.[83]

Greece is also the market leader in exports of solar collectors within the Single European Market. Over 50% of all solar systems using solar energy for heating installed in the EU were produced in Greece. The high quality of the products is a fundamental factor in the large market share currently held by Greek solar collectors. Some years ago the 'Dimokritos' research centre and the Centre for Renewable Energy Sources (KAPE) effected major quality improvements and expanded the range of possible applications, in close cooperation with the production companies.

There also appear to be considerable opportunities for developing the photovoltaics market in the near future, although here development is only just beginning. As yet the tax concessions for PV installations, which are around the same level as those for solar heating systems, have had little impact on buying behaviour, in view of the fact that they are considerably more expensive to buy than are solar heating systems. The same applies to installations utilising geothermal energy.

3.4 Continuing training initiatives in wind energy use in the Netherlands

The ECN energy research foundation[84] is the leading institute of energy research in the Netherlands. ECN has its own research field for solar and wind energy.[85] In this field, the institute has been holding international continuing training courses for a number of years. The ninth 'International Course on the Implementation of Wind Energy' will be held in April 2000.[86]

The particularly innovative aspects of this course are the provision of comprehensive knowledge of the entire planning and implementation process, the strongly integrated transnational dimension, and the interactive approach, designed to motivate participants to take an active part in the course. This means that energy experts participating are given a major opportunity to bring their specific experience in this field and current developments in their countries of origin into the course. The course gains a further international dimension by taking account of technologies that are, in particular, viable for developing countries.

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[81] However, the proportion of houses, which constitute the most important market segment for solar systems, is higher in Cyprus than in Greece.

[82] The data relates to the Republic of Cyprus.

[83] In Austria, in 1998 combination systems of this kind already accounted for almost 50% of all solar installations.

[84] ECN's website address is http://www.ecn.nl and its telephone number is +31-224-564949.

[85] ECN's website provides much information on the renewable energy sources sector in the Netherlands, e.g. addresses, publications database.

[86] Detailed information on the course is available on the website http://www.ecn.nl/edu/9ewinde/index.html. The evaluation report on the eighth wind energy course, which was held in 1999, is available from ECN as a booklet in English. The eighth wind energy course attracted 22 participants from research institutes and energy companies in Belgium, the Netherlands, the UK, Argentina, China, Costa Rica, Cuba, Guatemala, India, Indonesia, Malaysia, the Philippines, Poland and Sri Lanka.

Following an introduction to the specific features of technologies for using wind energy, the planning and implementation process is covered in four teaching units (energy planning, financing, construction and maintenance of the installation).

The target group comprises energy experts interested in the field of wind energy, and in particular project managers from research institutes and national and private energy companies.

The course is held in English and lasts two weeks. It involves six days of lectures and seminars and four days of practical work. The course also offers a platform for dialogue and for an exchange of opinions and experiences.[87]

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[87] http://www.ecn.nl/edu/9ewinde/index.html

An abridged version of the Internet description of the course structure follows:

Wind Resources

The wind conditions at a site determine whether wind energy may be a viable option or not. The main characteristics are average wind speed; frequency distribution; gusts and lulls; turbulence. This lecture gives a short introduction to wind resource assessment, including the evaluation of existing wind data and the purpose of measurement programmes. Basic rules are given to estimate the wind energy potential, and the influence of the local wind regime on the energy production is explained. Finally, some recently developed tools, such as wind atlases and siting computer programmes, are treated.

Introduction to Wind Energy Technology

This lecture explains the working principles of large, grid-connected wind energy technology systems. A minimum technological knowledge is indispensable to understand the possibilities and limitations of wind as an energy source. Topics dealt with are aerodynamics; mechanical structure; safety & control; grid connection. The emphasis is on concepts instead of formulas to address participants who have a non-technical background.

Planning Phase

The integration of wind energy in the national energy production involves issues such as: the wind energy potential in relation to the national resources and energy demand; structure of the national electricity sector; siting and matching of wind turbines; wind energy production versus demand; penetration level; macro-siting and environmental aspects. The added value of wind energy is discussed: fuel saving, avoided emissions, capacity credit.

Grid Connection of Large Wind Turbines

The integration of wind turbines in a national electricity infrastructure involves technical, legal and economic aspects. Technical aspects are the wind turbine characteristics, grid layout and operating strategies. National legislation defines the structure of the electricity producing and distributing sector, tariffs and types of contracts. Economy includes the tariffs, production costs, and possibly incentives for renewable energy sources. The lecturer will explain the required conditions for grid connection of large wind turbines.

Pre-Investment Studies

A pre-investment study is carried out in order to decide whether a wind energy project is feasible or not. The study should prove that the planned project is technically and economically viable and bankable. The most relevant aspects are treated, including choice of technology, grid connection, banking schemes, site preparation and environmental issues. A worked-out case will be followed by an exercise.

Financing Schemes of International Donor Agencies

After the UNCED conference on global environmental issues (Rio de Janeiro, 1992), the World Bank was one of the first international agencies to present a financing scheme for renewable energy technologies. Other programmes followed such as Finesse and the more recent Joint Implementation initiatives. The lecturer will explain their history and the status of renewable energy sources within global energy policies, and will give an overview of current developments and possible finance schemes.

Implementation Strategies

The introduction of wind energy in a country requires support by a national energy policy. A number of legal and economical measures, such as tax incentives, subsidies and a revision of the tariff structure may be conceived for this purpose. This lecture will provide an overview of the strategies applied in the United States, Europe and India. The current developments in Europe in the context of the liberalisation of the energy sector are outlined.

Technology Assessment

This lecture presents the state of the art of current wind turbine designs. Methods are described to classify and evaluate different wind turbine types, including reliability, output, investment and recurrent costs, after sales services etc. The influence of clustering of wind turbines on the energy output is discussed. Documentation on commercially available wind turbines will be handed out.

Project Management

Aspects of project management are dealt with, such as establishing goals and conceiving strategies; project-cycle phases: plan of operations; operation; control & monitoring; evaluation. A worked-out wind energy demonstration project is presented, including the plan-op, project description, allocation of personnel and financial resources.

Manufacture, Installation & Monitoring

A rotor blade manufacturing company and a wind turbine manufacturer During this combined excursion to two leading Dutch companies, the strategies for manufacturing, installation, after sales and maintenance services will be discussed, as well as the possible set-up of local production versus import. Relevant aspects of the design and production process are explained, such as: Quality Assurance; ISO-9000 system; human resources; management tasks and employees categories. With respect to plant performance are treated: control and monitoring of availability; output and capacity; breakdowns and maintenance efforts; institutional infrastructure and role of authorities; insurances; sub-contractors and competitors.

Standards & Certification

The development of international (IEC) and national standards for wind turbines is outlined. The importance of certification and the relevant procedures and criteria, are discussed.

Operational Phase

Field Experiences and Monitoring

During this excursion to the 15 MW windfarm nearby the old fishing town of Urk, the experiences encountered during preparation, implementation and operation are discussed. Investment aspects are dealt with, as well as actual information on performance, operation and maintenance.

Additional lecture

Small Scale Wind Energy Systems

This lecture will give a short introduction to small-scale applications of wind energy for rural areas. The current status of water pumping windmills and wind electric battery charging systems will be given. These systems have a large potential worldwide, but also some bottlenecks making their practical dissemination cumbersome.

Practical Activities

Participants' Presentations

It is envisaged that the participants prepare and present a paper on the status of wind energy in their country. The individual viewpoints and experiences will be commented and discussed, so as to inform each other and to benefit by mutual exchange of experiences.

Excursion to ECN business unit Solar and Wind Energy and business unit Fuels, Conversion and Environment

According to individual interests of the participants, an excursion to several ECN facilities will be organised, e.g. wind turbine testing and monitoring facilities, wind turbine design by computer, solar cell testing and manufacturing laboratories, biomass installations and fuel cells.

3.5 Integration of unemployed young people and women into the labour market via environment-oriented continuing vocational training - Denmark and Sweden

3.5.1 Integration of unemployed young people into the labour market in Denmark

Many production schools (produktionsskole) have been set up in Denmark, to promote labour market integration of unemployed low-skilled young people. Young people normally attend the production schools for 12 months, but they can leave the school at any time if they have found a job or a training place. Over 5000 young(er) unemployed people currently attend the 107 Danish production schools.[88]

The innovative aspect of the production schools is the fact that teaching and training do not take the form of a fixed curriculum or modules, but follow outlines, in which training is tailored to students' individual needs. The basic concept involves learning jobs and activities by carrying them out, i.e. learning by doing. At the point when problems arise in a work stage, subject-specific theoretical instruction is provided, with the aim of solving or overcoming the problem. For example, if there is a problem with calculating quantities of wood or different measures for pieces of wood and items of furniture, a mathematics lesson is provided.

Many production schools offer students outlines that are strongly oriented to the environment. For example, a combination of practical training and theoretical instruction is offered in agriculture and forestry, landscape conservation, tourism, the textile industry, and assembly of solar collectors (assembling the components).

The fields of work and activity are often selected in collaboration with companies. Activities are learned and then routinely carried out. This training is often combined with teaching of multimedia skills and languages. Areas of instruction covered by all production schools, to a varying extent, in the context of this problem-oriented approach to learning are Danish, social studies, mathematics and current affairs. Students at many production schools can undergo a period of practical training in (local) public or private companies. In addition, student exchange visits within and outside Denmark are organised as part of the schools' activities. These visits focus on basic academic knowledge, history and culture, social skills, and skills specific to the occupation or sector.

The production schools cover approximately one fifth of their financing requirement through services and by manufacturing products for the local market. The remainder of the funding is provided by the State (Foreningen for Produktionsskoler og Produktionshojskoler, 1997).

Examples of production schools with a strongly environmentally oriented teaching and training content are the Nature School at Roskilde, the Environment and Nature School at Ringsted, and the Pile Mølle production school at Ishøj.

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[88] Telephone interview with A. Hiss, Director of the coordination office for production schools, Vejle/Thessaloniki, 10.9.1999.

At the Pile Mølle production school, young people are offered outline training in *nature and environment, children and environment*, craft outlines in wood and metal processing, and a tourism outline with a strong element of transnational teaching and training activities (Foreningen for Produktionsskoler og Produktionshojskoler, 1999).

The *nature and environment outline course* covers the routine tasks involved in biological horticulture (growing vegetables and flowers), in the school's own garden, and provides instruction in the theory of biological agriculture and in overcoming all the problems arising in the context of work in the garden (growing, harvesting, storage). An example of activities in the *children and environment outline course* (also known as the *pedagogic outline*) is the planning of a kindergarten, taking account of environmental principles, which was then set up. Participants also undergo periods of practical experience in kindergartens. In addition to covering fundamental environmental correlations, theory classes concentrate in particular on issues relating to child rearing. In the tourism course, practical classes are held in the municipality's own beach area. Theory classes cover local history, tourist services and foreign languages.

In addition to carrying out other activities, the production school's EU Centre coordinates two projects subsidised by the EU, focusing on training-related transnational youth exchanges.

3.5.2 Integration of unemployed young people into the labour market in Spain - initiative for implementation of a production school in accordance with the Danish model

In the Spanish province of Murcia, the transnational *Prodyouth* project is currently endeavouring to establish a production school based on the example of the Danish model.

The aspect that is particularly innovative for Spain is the motivation-oriented alternative learning concept, designed to motivate young people much more strongly to learn and to work to acquire skills than is the case in the *Escuelas de Taller* (Spanish 'workshop schools') set up for excluded young people. Motivation of young people constitutes a fundamental problem in many *Escuelas de Taller*. However, even those which operate efficiently do not usually reach the level of skills training and motivation to learn achieved in the Danish production schools.

This initiative is focusing on the acquisition of knowledge and performance of activities in biological agriculture, landscape conservation and rural tourism. One area on which it is concentrating is the provision of knowledge of new technologies in agriculture and their practical application. An environmental camp is also to be set up. In addition to the problem of securing long-term financing for this project, the legal framework conditions constitute a particular obstacle, since they prohibit schools in Spain from being geared to profit. In order to fulfil the legal criteria, an association founded for the purposes of this project is to carry out these activities. The pilot phase of the project is largely being financed by the

Youthstart Programme (Asociacion Columbares, Proyecto transnacional *Prodyouth*; columbares@distrito.com).[89]

3.5.3 Integration of unemployed women into the labour market in Sweden

The EU-subsidised project *Sustainable Energy and Environment* (SEE) was aimed at developing and then holding a one-year course[90] for unemployed women.

The particularly innovative aspect of the project lies in the high level of harmonisation of the course content with current skills requirements in the local and regional construction sector, and the strongly project-oriented course design, attuned to the main individual interests. In addition to providing course participants with the appropriate skills required in the construction sector, this was also aimed in particular at supporting increased development of key competences.

In the first part of the project, SEE ADAPT, skills requirements in the local construction sector in relation to energy and the environment were identified in direct collaboration with companies. The structure of the second part, SEE NOW, was developed on the basis of these findings.

In the SEE NOW stage of the project, unemployed women from the construction sector, with university-level training (architects, engineers), were equipped with sound knowledge in the field of energy and the environment in the context of the construction sector. The aim was to equip course participants to work as environmental and energy consultants in the construction sector once they completed this training course.

Once the curriculum had been developed, a one-year pilot course was launched with 13 unemployed women. The course ended in summer 1999. The participants in the course had already completed their training, but had little or no professional experience.

The course structure was very flexible and project-oriented. The emphasis was on implementation of individual projects on the basis of the participants' own proposals and interests. It was not uncommon for participants to work in a local/regional enterprise for a short period. Examples of this are work on planning for a 'zero energy house'[91] in the town of Falkenberg and work on an environmental management system in a regional enterprise (Axelsson H., 1999).

The recently completed course has not yet been fully evaluated, but five women left the course before the end because they had in the meantime found jobs as environmental and energy consultants (Axelsson H., Halmstad University, 1999).[92]

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[89] Interview with Pilar Lucio, Youthstart Conference, Hervas, 10.12.1999.

[90] The precise duration of the course is 50 weeks.

[91] This means that all the energy consumed by the house originates from renewable energy sources.

[92] Harriet Axelsson was the coordinator of the SEE NOW project and presented an initial interim report on the course to the *Conference on Environmental Education and Training in Europe* (European Commission) on 4.5.1999.

3.6 Environmental training initiatives of the social partners in Austria and Sweden

3.6.1 Incorporation of occupation-specific environmental skills into apprenticeship/training in the metal, electrical and energy sectors in Austria

As a result of the steady increase in environmental awareness in the population, ever more customers are interested in environmentally sustainable products and, in particular, in alternatives to traditional energy systems. Environmental skills and competences have therefore become considerably more important in many industrial sectors.

In 1996, following an initiative by the metal/mining/energy trade union (GMBE) of the Austrian trade union federation (ÖGB), after a number of rounds of negotiations, the social partners agreed that environmental skills should be incorporated into the job profiles of various training occupations in the metal and electrical sectors.

The first agreements were concluded in February and March 1996 and related to incorporation of environmental skills into the job profiles of the training occupations *communications electronics engineer, sanitary and heating engineer,* and *production engineer.* In subsequent years, there followed agreements of the social partners for other occupations and an agreement on incorporating general environmental knowledge into all occupations in the metal, electrical, energy and related sectors.

The innovative aspects of this initiative by the social partners are their commitment and their specific agreements on incorporating environmental skills into the job profiles of the sectors concerned. However, other innovative aspects are the content of these vocational training measures and, in particular, the fact that following their translation into law, they are obligatory for both vocational schools and enterprises. Similarly to the situation in Germany, under the dual system in Austria, teaching of the skills laid down in the job profile is compulsory for apprenticeship/training (Loos R., 1996).

The relevant amendments to the Law in accordance with the social partners' recommendations have now been implemented by the Ministry of Economic Affairs, which has competence in this field.[93]

The provision of general environmental knowledge and global environmental correlations is now a compulsory feature of apprenticeship/training in all training occupations in these sectors. For four occupations in these sectors, the provision of occupation-specific environmental content during training is also a compulsory feature, both in vocational schools and in enterprises[94]. For the training occupation sanitary and heating engineer, for example, one of the four occupations concerned, this means incorporating basic knowledge from the fields of solar heating, photovoltaics and geothermal energy into the training.

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[93] In Austria, agreements of the social partners carry great weight. Joint recommendations by the social partners in the field of apprenticeship/training are usually translated into law by the Ministry of Economic Affairs.

[94] Definition in accordance with job profile: *basic knowledge of enterprise measures relating to sensible use of energy in the area of work relevant to the occupation.*

However, the definition in the job profile does not stipulate that extensive job-specific skills training measures must be implemented. Thus the form the initiative takes is essentially left to the individual enterprise or vocational school. However, it is compulsory for every enterprise and vocational school to teach general environmental knowledge and basic environmental correlations.

The main things the trade unions expect to achieve by means of these regulations are improved job security as a result of new orders and tasks and, in some cases, the creation of new jobs. The industrial associations focus on more efficient customer service from skilled workers with energy-saving products and services. Only with their aid can industry optimally open up new markets for environmental technologies and products (Loos R., 1997).

3.6.2 Research and Study Circles for corporate environmental protection in Sweden

The main innovative aspect of the Research and Study Circles (RSCs) lies in the alternative approach to learning and/or the transmission of knowledge, which acquires additional dimensions thanks in particular to their composition (trade unionists, workers, scientists). The group discussions provide all participants with new knowledge and open up a wider perspective for understanding of environmental issues within and outside the enterprise.

University scientists and workers meet in the RSCs at regular intervals (usually once a month) to discuss environmental topics (e.g. local or corporate environmental problems). The group draws up new proposals for improving local or corporate environmental protection. The participation of a scientist in the group's meetings is designed to bring in new findings and possible solutions. The exchange of opinions and the discussions provide workers with an extensive and deeper understanding of corporate environmental protection and global environmental correlations. The discussions also foster the workers' communication skills and make them better able to take action and solve problems on their own account. Thus the knowledge and skills provided by the RSCs go beyond environmental topics and corporate environmental protection in the narrower sense of the terms.

In the 1970s, the RSCs dealt in particular with occupational health and labour law. In the 1980s, the RSCs increasingly disappeared, because the universities lost interest in working with them.

The RSCs were not really reborn until 1997. Their rebirth was triggered by the Leonardo da Vinci 'Environmeth' project when scientists from the University of Lund, trade unionists from the LO and workers from the KappAhl company initiated new RSCs. A crucial part was played by good cooperation from the local management of the KappAhl company in Lund[95].

However, the close cooperation between scientists and blue-collar workers in the RSCs' discussions has consequences that go beyond learning and changes of attitude on the part of the workers. It also equips scientists with values derived from social experience and affects the selection of research topics for projects (Axelsson H., 1999).

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[95] KappAhl is a commercial chain with a workforce of 2300.

3.7 Local environmental education and training initiatives in Luxembourg

Luxembourg offers no examples relevant to the subject areas addressed above. Two regional examples have therefore been selected for description. The two local initiatives in Luxembourg described constitute important innovations for the country itself, but in comparison with the other examples, they are less important in the context of transfer to other States.

The technical secondary school at Dübelingen implemented a model initiative at local level, in cooperation with the local authority. Within the framework of an EU-subsidised project, electrical fitters were taught general and job-specific environmental skills during their training.

The particularly innovative aspect of the project is that the interdisciplinary and subject-specific training content it developed is used in different subjects at this school (workshop classes, electrical engineering, electrical systems, environmental and health education, language classes). As teacher-centred teaching dominates education even more strongly in Luxembourg than in some other Member States, this interdisciplinary approach represents an important experience for the students and teachers involved in the project.[96]

The medium-sized company Ewald Giebel Luxemburg GmbH (steel-band galvanising plant, 116 employees) has ISO 14000 certification and implements internal and external continuing training programmes for its employees in the field of environmental protection.

The in-house continuing training measures in particular are innovative, as regards the structure of both their organisation and their content. Every three months, a workshop lasting several hours is held in the workplace, coordinated with the shift changeover to ensure that all workers can attend. The content of these workshops covers the specific environmental protection problems arising in the relevant workplace, such as dealing with wastes or safety measures for dangerous work processes. General knowledge of environmental correlations and environmental protection measures is deepened by means of company excursions twice a year to other companies in the same sector. Around 50% of the workforce participate in the excursions. The Chamber of Trade and Industry arranges other external continuing training events (Kress O., 1999).

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[96] Pauly M. et al., 1998. Strom sparen - Umwelt wahren. Ein Umweltprojekt für Elektroinstallateure in der Ausbildung. http://www.ltnb.lu/webmast/web/LTNB_Projets/stromsparen/index.html

Chapter 4: Skills requirements in environmental vocational training - transfer of innovative practices

4.1 Skill requirements in environmental vocational training at skilled-worker level in the use of renewable energy sources

The environmental knowledge required to exercise an occupation can basically be divided into two fields:

- general knowledge relating to environmental problems, environmental correlations and environmental cycles;
- occupation-specific knowledge to the extent necessary for the relevant job.

Every environment-oriented job involves a fundamental need for general knowledge about environmental problems, environmental correlations and environmental cycles. The importance and fundamental relevance of general environmental knowledge should not be underestimated. A lack of understanding of environmental correlations and cycles reduces or even completely prevents efficiency in environment-oriented job activities. They are of particular importance in customer advisory services. For example, if a skilled worker in a firm of fitters or electricians does not possess the appropriate level of environmental understanding, he will not be able to advise customers interested in ecological products and services efficiently.

An example from Austria, which makes the negative consequences of inadequate environmental knowledge particularly clear, is that of the motor vehicle mechanic, in relation to the use of RME[97] as an alternative fuel for cars. In Austria, several RME plants[98] have been in operation for some years in the four Provinces (Upper Austria, Lower Austria, Burgenland and Styria), producing rapeseed oil diesel. These Provinces now have an efficient sales network with many filling stations selling biodiesel (Loos R., 1997).

When interested customers ask if biodiesel is suitable for their car, the majority of motor vehicle mechanics in regional workshops reply that this fuel can only be used for tractors. In addition to the lack of *job-specific knowledge* (bio-fuel can be used in most newer car types), many mechanics lack *general environmental knowledge*. They do not know about the correlations between natural CO_2 and the biodiesel cycle. They do not know the fundamental difference between emissions resulting from fossil fuels and those resulting from biodiesel. They do not know that RME diesel represents a renewable energy source.[99] The result of this lack of knowledge is that customers interested in bio-fuel are informed that this is no better for the environment than fossil fuels (Loos R., 1999).

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[97] Rapeseed oil methyl ester diesel (biodiesel).

[98] Plants producing rapeseed oil methyl ester diesel.

[99] The difference lies in the fact that the CO_2 released by biodiesel was previously assimilated from the atmosphere by the rape plant during its growth process, and the atmosphere is therefore not subjected to additional CO_2 accumulation.

Thus a general understanding of the environment and knowledge of environmental correlations and cycles constitute the basic knowledge on which specific environmental knowledge important to the occupation concerned can build. They are important to all occupations, as all jobs exert specific influences on the environment and environmental cycles. Their importance will increase further in future.

The skills required in the context of use of solar energy can be divided into two areas. In addition to knowledge and skills relating specifically to *solar heating*, this field requires a basic knowledge of hydraulics. In *photovoltaics*, in addition to knowledge and skills relating specifically to this field, a basic knowledge of electrical engineering is required.

In the context of use of geothermal energy[100], in addition to specific geothermal knowledge, the skilled worker must have a knowledge of and skills relating to hydraulics and electrical engineering.

In order to provide for quality assurance of products and services in the field of solar technologies, it is very important, at skilled-worker level, for general environmental knowledge and the appropriate occupation-specific basic knowledge to be imparted in initial vocational training. This relates to knowledge of environmental correlations and the provision of solar-heating knowledge and skills in dual training for fitters (gas/water fitters) and photovoltaics skills in electricians' training (electrical fitters). It is also desirable for trainee fitters to be equipped with knowledge relating to installing heat pumps. This is a relatively sophisticated task, as it requires not only a considerable knowledge of hydraulics, but also electrical knowledge. Skills training should consist of theory classes and practical sessions in an enterprise or training workshop. In continuing vocational training, skilled workers in enterprises in these sectors selling and installing solar-technology products should acquire more extensive skills via continuing training courses.[101]

Environmental skills can also be divided into the fields of reactive and preventive environmental protection. Knowledge on the subject of environmental protection exclusively limited to reducing local environmental pollution that has occurred or to efficient handling of wastes can be classified as reactive environmental protection, in terms of content. Environmental knowledge which also involves preventive measures for avoiding waste, saving energy or using alternative energy sources can be classified as preventive environmental protection. Only in principle can the two fields of skills be completely separated. However, it should be borne in mind that an understanding of preventive environmental protection also includes a basic knowledge of reactive environmental protection, while it is possible to have a basic knowledge of reactive environmental protection dissociated from the context of a knowledge of preventive environmental protection (although this is not desirable).

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[100] Minimal-depth heat pump installations primarily involve utilisation of solar energy.

[101] Telephone interview with F. Roiz, Head of the First Viennese Solar School, Vienna/Thessaloniki, 30.6.1999.

4.2 Transfer of innovative practices

In Austria, the First Viennese Solar School offers a comprehensive and interdisciplinary programme of continuing vocational training in solar technologies for skilled workers and graduates of higher technical training institutions.

The establishment of a similar training institution in Greece would be very significant, as the solar energy market is already highly developed, but continuing training initiatives for skilled workers are lagging behind market development. The University of Athens, partner in the Leonardo da Vinci project *'European Solar School'*, coordinated by the First Viennese Solar School, plans to set up a training establishment of this kind. In this context, the heat pump module in particular would be completely new to Greece. This field is suffering even more than solar energy utilisation from the absence of a comprehensive continuing training programme for skilled workers.

It would also be desirable for a training establishment modelled on the *Eropean Solar School* to be set up in a number of northern European States (e.g. Denmark). Both the full 'Solarteur' training and training in one of the modules would open up new prospects for interested skilled workers. Workers who complete the three-day Danish courses in solar heating and photovoltaics in particular could use this continuing training programme to extend their knowledge and skills.

A transfer of the innovative *European Solar School* model to the Member States bordering the western Mediterranean (particularly Spain and Portugal) could play a major part in developing the great market potential. Well-qualified skilled workers would awaken customers' interest and gain their trust by giving them expert advice and offering efficient installation. Increased State and/or regional subsidies offered, similarly to those in Denmark, on condition that the solar fitters possess the appropriate course certificate, could provide crucial support for market development and for the implementation of vocational training measures.

4.3 Skills requirements for environmental vocational training measures to integrate *low-skilled young people and unemployed women into the labour market*

Environmental training and continuing training courses can help to better integrate young people with few skills into the labour market. (Continuing) training courses for unemployed young people and younger participants in the labour market should be geared to practice as far as possible, although theoretical knowledge in the context of the planned occupation should also be imparted. Occupational fields particularly suitable for this group are agriculture and forestry, landscape conservation, eco-tourism, wood processing and the production of environmental engineering products. Waste disposal and recycling activities are another possible field, provided that measures are in place to protect workers' health.

4.4 Transfer of innovative practices

Environmental vocational training plays a key part in the Danish production schools. The transferability of this model to other Member States in which no similar initiatives exist would result in new job prospects and motivation for low-skilled young people. However, the issue of financing is the main impediment to this. The costs public establishments would incur could be reduced by means of increased cooperation with local/regional enterprises. At the same time, direct sales of products and services to customers should be increased.

The increased revenue anticipated from direct sales could motivate young people to learn how to make more complex products or to offer more extensive services. The high level of motivation and the good working atmosphere in the Danish production schools show that the conditions for implementing this project would be good. Consequently, the concept of the production school as a training workshop and profit-oriented enterprise for marginalised young people could be expanded somewhat. Legislative provisions similar to those in Denmark would also have to ensure that the schools were permitted to undertake business activities on this scale, but that the young people themselves benefited from them.

With regard to the Swedish SEE NOW project, similar sector-specific initiatives for unemployed female graduates would help to increase their job-related skills and competences and to reduce unemployment. The content of the project-oriented approach in this pilot project should be attuned to the skills requirements in the relevant country or region.

Chapter 5: Creation of a quantity of new employment and new jobs at skilled-worker level in the environmental sector

The new fields of activity and markets in environmental protection and environmental technology have created a considerable quantity of employment, and this is set to expand further in future.

However, this development does not always mean that the net volume of employment in an enterprise, a region, or even the economy as a whole increases on the same scale, as sometimes it involves 'only' a shift from work on less environmentally sustainable products and services to work on more environmentally sustainable products and services: the increase in the volume of employment as a result of environment-oriented activities does not primarily create new jobs, but makes existing jobs more secure as a result of the increased utilisation of the enterprise's capacity (Loos R., 1997).

The extent of the impact on employment varies from one field of environmental technology to another and one sector to another. Furthermore, the short- and long-term effects may vary just as much as the effects and consequences on individual industries and industry as a whole in respect of workers with different skills. Jobs are also dependent on the mode of functioning and flexibility of markets and the intensity of competition on them. Since the impetus for strengthening environmental protection does not come only from market signals, its impact on employment is also determined by the framework conditions of national and international environmental policy (Pfeiffer F. et al., 1999).

It is not possible for this report to discuss these issues in detail or to provide quantitative data documenting the scale of the effects on employment for the individual environmental technology sectors. At the time when this report was completed, relatively little quantitative data was available in this field. In the next stages of the Cedefop project 'Observing innovations in vocational training', the data currently available will be compared and assessed.

Some key areas of environmental technology at micro-level will be discussed in more detail below. The aim is not to conduct an overall assessment of these areas, but rather to indicate the issues it is most important to take into account in a comprehensive analysis.

5.1 Solar technologies

A firm of fitters or electricians that expands its service range to include solar technologies acquires new sales markets and utilises the capacities of its employees more fully as a result of new orders. The jobs concerned become more secure. The enterprise profits financially from the new orders and at the same time acquires a new segment of the market, which helps to ensure both that the enterprise is profitable and that employees' jobs are more secure in the longer term. Only rarely does the net volume of new employment in smaller business enterprises in this sector increase as a result of these new activities to such an extent that new employees have to be taken on. However, in larger firms in particular, production and sales of solar collectors can, with an appropriate increase in demand, create a considerable potential for new jobs (Loos R., 1997).

An increase in demand would also create new jobs in solar collector production. The number of jobs would depend on the size of the increase in sales. So far an important production market has evolved in Greece, within the EU, and in Cyprus, one of the candidates for accession (Chamber of Trade and Industry, Nicosia, 1999, Statistics on the solar heating market).

5.2 Environmental protection within companies (corporate waste and recycling management)

As a result of new legislative provisions in various Member States, corporate environmental protection has greatly increased in importance, particularly as regards larger companies. Companies are also increasingly willing to implement environmental management systems voluntarily, in order to improve their image in the public eye and with customers, and to be more economical in their use of resources and thus save the company money.

This trend has generated a quantity of new employment in many companies. Occasionally this has also resulted in the creation of new jobs. However, the emphasis is mainly on creating new tasks and activities for existing jobs, rather than actual job creation. Company surveys in Austria have shown that in a medium-sized company, a company environment and waste officer spends on average 20-25% of his working hours on tasks associated with this function. The industrial sites of large companies usually have one (or sometimes two) environment and waste officer(s) carrying out this activity as a full-time job, while their deputies spend only part of their working hours on it. Irrespective of whether the activities are full-time or part-time, these work duties constitute a new net quantity of employment, since they do not replace other tasks or activities either within or outside the company (Loos R., 1997).

5.3 Local-authority advisory activities on the environment and wastes

In recent years, in many Member States there has been a substantial increase in the importance of advice on the environment and wastes for local inhabitants from advisers appointed by local authorities. Innovative legislative measures, such as those in the Austrian Province of Styria, where all municipalities with more than 30 000 inhabitants have a statutory obligation to employ an environment and wastes adviser (to advise citizens and those managing local-authority activities in this field), help to increase the numbers of those active in this area. Irrespective of legislative measures, however, increasing numbers of local authorities are showing an interest in employing such advisers voluntarily, as a contribution to the Climate Alliance (Loos R., 1997).

5.4 Local-authority and private enterprises in the waste disposal and recycling sector

In many Member States, local-authority waste disposal has broadened its traditional waste collection activities to include separating wastes into types (paper, glass, metal, residual and special wastes). However, this has created virtually no new jobs.

On the other hand, many new jobs have come into being in recent years in private recycling enterprises and, in some cases, local-authority[102] recycling enterprises. Even in Member States where expansion of this sector has already made great strides, there is still potential for development in the shape of types of recyclable waste not yet, or so far only very rarely, included in the recycling process. In Austria, for example, there are 240 private enterprises whose sole activity is recycling. They employ 1500 people. However, there are many other enterprises manufacturing both original and recycled products (Austrian Ministry of Economic Affairs, Energy Recovery Agency, 1999).

Only in some cases do the new employment that has been generated in this sector and the new jobs that have been created constitute net gains, as in the business and product cycle, they reduce the quantities of secondary materials (paper, glass, metal, synthetics) and hence also the work input associated with their production. However, it would be wrong to equate this completely with the resulting loss of employment volume. Although there is a reduction in production of secondary materials (paper, glass, some types of metal, some types of synthetics) from raw materials, this being replaced by production of secondary materials from recycled wastes, the numbers of work activities generated by recycling are higher than the numbers associated with the conventional production process.

Only some of the additional volume of work is generated in production itself, as many production processes operate automatically. Other linked activities are often more important, in particular administrative office work and transport. This effect is intensified by the many enterprise start-ups in the recycling sector and the predominantly small-scale industrial structure in this sector in some Member States. An important growth sector has come into being in this field, but as yet no other enterprises have closed as a result. It can be assumed that new jobs will continue to be generated in this field in the future. There is a particularly significant potential for new jobs and a new employment volume in this sector in Member States only just setting out along this path.[103]

However, without a doubt, quite apart from the important ecological dimension, the primary importance of the new environmental work activities and markets lies in the increase in utilisation of workforce capacities in the companies concerned, as a result of innovative products and new services, and hence in the improved job security and the support for the dynamics of business processes.

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[102] In many EU Member States, the majority of recycling is carried out by private enterprises.

[103] Interview with T. Schulze-Bauer, Association of Austrian Waste Disposal Companies, Vienna, May 1996.

Conclusions

The structure of vocational training in the environmental sector varies in the countries discussed. The specific national framework conditions of the vocational training systems have also given rise to different approaches to environmental vocational training in the individual countries. However, the development trends, initiatives and provision structures of environmental vocational training in the individual countries also share many common features and similarities.

Germany, Denmark and Austria in particular have adopted similar approaches to ***incorporating environmental skills into apprenticeships/traineeships***. In all three countries, an attempt is made to achieve blanket incorporation of environmental skills into the dual system. In Germany and Austria, the social partners in particular have launched major initiatives in specific sectors (e.g. the metal, electrical and energy sectors). However, agreements of the social partners and subsequent legislative action, as in Austria, for example, are tailored to the specific framework structures of the dual training system, and can thus be transferred to other Member States *only if account is taken of the specific training structures in the country concerned.*

EU directives, EU training-subsidy programmes and project partnerships subsidised by the EU help to achieve an increase in training initiatives with similar basic structures in the Member States. An example of this is the EU Directive on authorised persons for hazardous goods, which Member States must incorporate into national law within a set transitional period. Among other things, the Directive lays down comprehensive training measures in accordance with common criteria. However, the form specifically taken by the relevant training courses is laid down at national level. 'Synchro', an Leonardo da Vinci project managed by BFI Vienna with partners from Greece, Germany and the United Kingdom, attempted to develop standardised transnational modules for training for authorised persons for hazardous goods. As a result of this project, which has now been completed, BFI Vienna now has appropriate course modules and plans to implement them more widely. However, it currently seems unlikely that its project partners or other institutions in their countries will use them.

The *lack of efficient implementation strategies* for *the course modules and practices developed* is a fundamental problem for many completed Leonardo da Vinci projects. The example of BFI Vienna shows that modules will be implemented in continuing vocational training above all when the institution responsible has *a direct practical interest and when its own infrastructure fulfils the conditions for implementation.*

In the field of ***training for skilled workers in solar technology and geothermal energy***, **Austria**'s First Viennese Solar School offers interdisciplinary training providing theoretical content and practical skills on a large scale. In **Germany**, several training initiatives (including the Berlin Solar School) also provide comprehensive training for skilled workers and other target groups in this field. In **Greece**, the market leader for solar collectors (both at national level and in terms of exports within the Single European Market), some specialised institutions of higher education offer a fairly comprehensive training content in this field, but in the context of initial and continuing vocational training for skilled workers, the training offered primarily consists of *training measures for the unemployed in the form of short courses*. These courses do not usually involve a final examination. The rule that skilled workers employed by companies may not attend subsidised courses *makes it difficult to impart these skills to the direct target group*.

If the BFI Vienna training concept, that of the Berlin Solar School, and the interdisciplinary solar-technology training course developed by the Leonardo da Vinci *'European Solar School'* project were to be transferred to Greece and implemented there, this would considerably raise the skills level of skilled workers in this field. The relevant skills requirement exists to a high degree. This applies both to current tasks and to innovative products and services in this field, such as solar heating/part-solar space heating combination systems, or energy audits for buildings. Depending on the main skills requirement, the *'European Solar School'* modules could be offered individually or in combined form, as interdisciplinary training. There is currently a greater need for the former, but interdisciplinary training in solar heating, photovoltaics and geothermal energy is becoming increasingly important. In addition, the current Leonardo da Vinci project*, 'model of an expanded heat pump installation and use as a fixed component of initial vocational training'*, under the project management of Kreishandwerkerschaft Frankenberg (with partners from Austria, Greece and Spain), could help to ensure that appropriate initiatives for initial vocational training of skilled workers are also launched.

The one-year Master's course, 'European Solar Engineering School', introduced for the first time at a **Swedish** university in September 1999, shows that solar-technology training initiatives are also being launched in Member States where market development is at a very early stage. The Censolar continuing training centre in Seville, which offers distance learning courses, and, in the context of secondary-level vocational education, a technical secondary school in Murcia, inter alia, represent innovative initiatives involving the provision of solar-technology training content in **Spain**.

In 1992, in **Denmark**, the State energy agency and production and sales companies agreed that only trained fitters with a solar heating certificate may install State-subsidised solar heating. This was designed to ensure that the systems installed functioned correctly. The three-day training courses in solar heating have been available since 1993 at two technical secondary schools, in cooperation with the Danish Institute of Technology. A similar agreement was concluded in 1998 to assure the quality of photovoltaics installations.

The Danish production schools offer special training courses for ***unemployed young people***, designed to (re)activate or reinforce participants' motivation to learn. Particular use is made of alternative approaches to learning to impart knowledge and skills. Thanks to cooperation with industry and sales of their own products and services, the production schools are able to cover some of their operating costs themselves. It could be made possible or easier to transfer this model to other countries (as is currently being attempted by the project initiative in the Spanish province of Murcia described earlier, for example) by means of efficient cooperation with local companies and sales of the school's products and services, bringing in the greatest possible return for the school and the young people themselves.

The SEE NOW project, designed to provide ***unemployed women graduates*** with sound training qualifying them to work as environmental and energy consultants, stands out in particular for the way in which it has coordinated the course content with the skills requirement in local and regional companies and for the project-oriented learning and work. As a result of cooperation with industry (periods of practical experience in companies and collaboration with companies in the context of projects) during the pilot course, the training was even more strongly geared to application-oriented content. At the same time, the project-oriented approach was designed to help participants to develop increased competences in the areas of independent planning, working and decision-making. In addition to the strong emphasis on the current needs of industry for subject-specific skills, the fact that this course initiative imparts these core or key skills also gives it an additional fundamental dimension as regards developing the skills and competences of the unemployed women participating. Similar initiatives could help to increase the integration of unemployed graduates in this sector in other countries and regions, particularly if the course content is effectively attuned to local and regional skills requirements.

Increased use should also be made of ***alternative forms of teaching and learning*** in the provision of knowledge and skills. Project-oriented learning and work in small groups are particularly suitable here. However, this concept must be adapted to suit the content and skills level of the different training courses. A purely project-oriented approach, as practised in the Danish production schools, is a suitable form for this skills level. In the SEE NOW energy-consultant training, despite the obvious success of the course, the project manager believed that not all the effects of the absence of any signs of a rigid course structure were positive. Therefore the aim should be to achieve a balance in the forms of provision, designed in accordance with the specialist field and skills level, but also including different and, in particular, alternative forms of learning. Furthermore, for many initiatives it is important to integrate the learning of practical skills more strongly with theoretical knowledge, in a well-coordinated combination.

The ***transfer of innovative practices*** developed via transnational projects and project partnerships can play a crucial part in improving the skills of employees in the Member States. It is not uncommon for Leonardo da Vinci projects to develop modules and learning aids that could considerably increase the efficiency of initial or continuing vocational training in particular occupations or groups of occupations, only for them not to be incorporated into vocational training owing to an inefficient dissemination strategy.

The ***commitment of the social partners*** to disseminating products developed in Leonardo da Vinci projects can result in increased implementation and application of these innovative practices in vocational training, but this commitment needs to be appropriately encouraged, inter alia by the project managers. In particular, trade unions and employers' associations should also be addressed at the relevant sectoral or occupational-group level, and they should be actively integrated into the dissemination strategy. Higher project budgets and compulsory documentation of success for an efficient dissemination strategy can open up prospects for improved implementation of project findings.

The Leonardo da Vinci projects on improving environmental skills in initial and continuing vocational training for skilled workers discussed in this report are good examples of commitment on the part of the representative institutions of employees and employers both to project management and to dissemination of the results.

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Vocational training and innovative practices in the environmental sector

A comparison of ten EU Member States, with specimen cases

Synthesis report in the context of the 'Observing innovations in vocational training' project

With its 'observing innovation in vocational training' project, Cedefop is supporting the European Commission in the analysis and dissemination of innovative practices. One of the project's priority areas is to study and assess innovations developed through the Leonardo da Vinci programme. This report on environment-related vocational training in Europe was prepared as part of the first stage of the project.

The report first of all explains the structure and methodology of the study and then, in Chapter 2, provides an overview of the current state of environment-related vocational training in ten Member States. Chapter 3 contains a short discourse on the concept and meaning of innovation from the point of view of system theory and for vocational training before going on to present and evaluate case studies of innovative vocational training initiatives from the Member States. Chapter 4 analyses environment-related qualification requirements for specific target groups. A discussion follows about the extent to which it is possible to transfer the good practices described to other EU Member States and thereby help to improve the level of training in those States. Chapter 5 estimates the new gainful employment and jobs created through environment-related occupations.

This report is intended to help to support decision-makers at the European, national and regional levels to implement innovative vocational training measures and practices by providing specialist information and application-oriented recommendations. However, this report is also intended to provide vocational training researchers active in this field with current information and leads to support their scientific work on environment-related vocational training in Europe and the improvement of that work.

Roland Loos

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